4951B PROTOCOL ANALYZER

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8-16. SCC (Serial Communications Controller)

The SCC is a dual channel I/O device which is primarily responsible for converting serial data to parallel during monitor mode operation; during simulate mode operation it converts parallel data to serial. Channel A receives DTE data and channel B receives DCE data. Data can be transmitted from either channel.

The clock for DTE synchronous data comes from DCE/DTE through U105 (TXCLK). The clock for DCE data is always present. It comes from DCE and is directly routed through U106 (pins 10 and 8) to the RXDB input on the SCC. For asynchronous data, the SCC's internal baud rate generator provides the clock to clock in data.

The SCC communicates with the HP 4951 primarily through an interrupt. A low indicates that the SCC requires service for some condition. When the CPU acknowledges the interrupt, the SCC puts an 8 bit vector on the Address/Data Bus describing the nature of the interrupt.

Multiplexer U208 demultiplexes which source of the RD, WR, and ALEM signals. In normal operation they come from the CPU. During direct memory access they come from the Tape Processor.

8-17. CRT Controller and Dual Port RAM Memory

The CRT controller and Dual Port RAM memory control the configuration and updating of video information.

8-18. Dual Port RAM

The CPU writes information into the Dual Port RAM to update the CRT display. Display information includes character, address, attributes, and timing, which are written into the first 2K of RAM. RAM is addressed through latch U308 to multiplexers U408-410. Multiplexers U408-410 demultiplex the addresses to RAM from the CPU and the CRT controller. The multiplexers are controlled by the arbiter circuit. Data from the CPU is input/output through transceiver U307. When the CPU is not using the Dual Port RAM, the transceiver is in a tri-state mode. Other devices cannot access the Dual Port RAM while the CPU has access. Most of the time the CRT controller (CRTC) has access to RAM to refresh the CRT. Control of the RAM is determined by the arbiter.

8-19. Arbiter

Two asynchronous devices, the CPU and the CRTC, share the same address space in the Dual Port RAM. The arbiter switches control of the RAM between the CPU and the CRTC during normal operation. The CRTC generally controls RAM. When the CPU requests access to update the display information, the arbiter puts the CPU into a wait state. Once the last instruction/character of the CRTC is finished, the arbiter switches control of the address and data lines to the CPU.

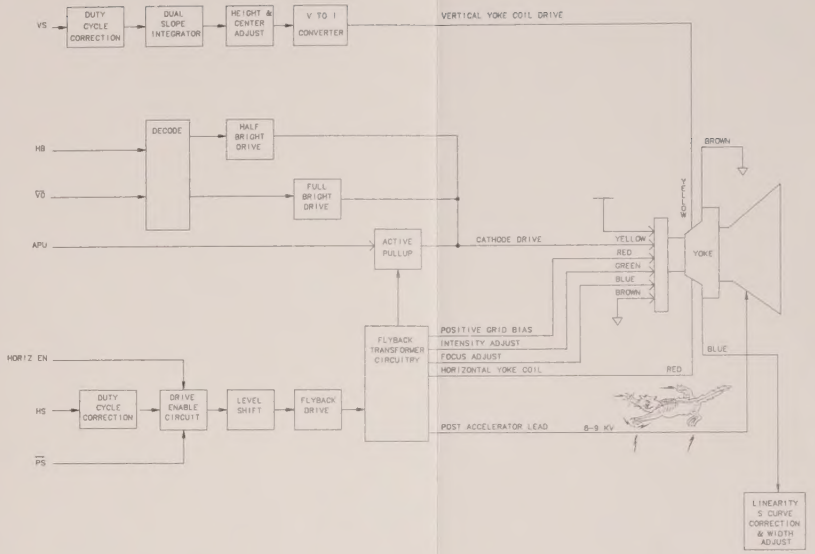


Figure 8-5. CRT Deflection Block Diagram

8-20. CRT Controller RAM

As display information is read from the Dual Port RAM, it is written to the CRTC's RAM. Since the display must be refreshed 60 times per second, this copy of the information is used to update the display when the CPU has control of the Dual Port RAM and the CRTC is locked out.

The transceiver (U307) in the data path isolates the data line outputs from the Dual Port RAM. When the CRTC reads from the Dual Port RAM, buffer U508 is enabled and the transceiver is disabled, information is brought into the CRTC RAM.

8-21. CRT Controller

The CRT controller is an I/O device addressed by the CPU. It is programmed with the parameters to drive the circuits, timing, addresses, and the ranges to generate the addresses for reading from RAM and generating display information, as well as the control signals to the CRT deflection circuit.

Video Display

Video information is defined by dots. A character is eight dots wide and 14 dots high. Each bit of character information read from the RAM contains both character and attribute information. For each character byte there is an attribute byte.

DOTCLK is the CRTC system clock, it is derived from a 4.9152 MHz crystal. The CRT controller is character, not dot, driven so DOTCLK is divided by eight to produce character clock to clock the CRTC. The least significant bit of address from the CRTC is character clock which gives a two byte transfer in one character time. Each character that is written into RAM is also latched into the attribute and character latches.

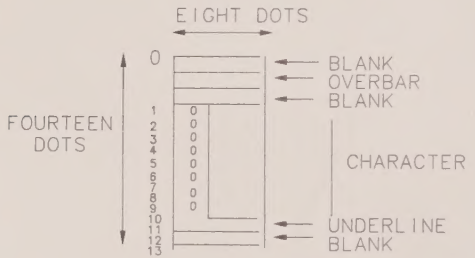
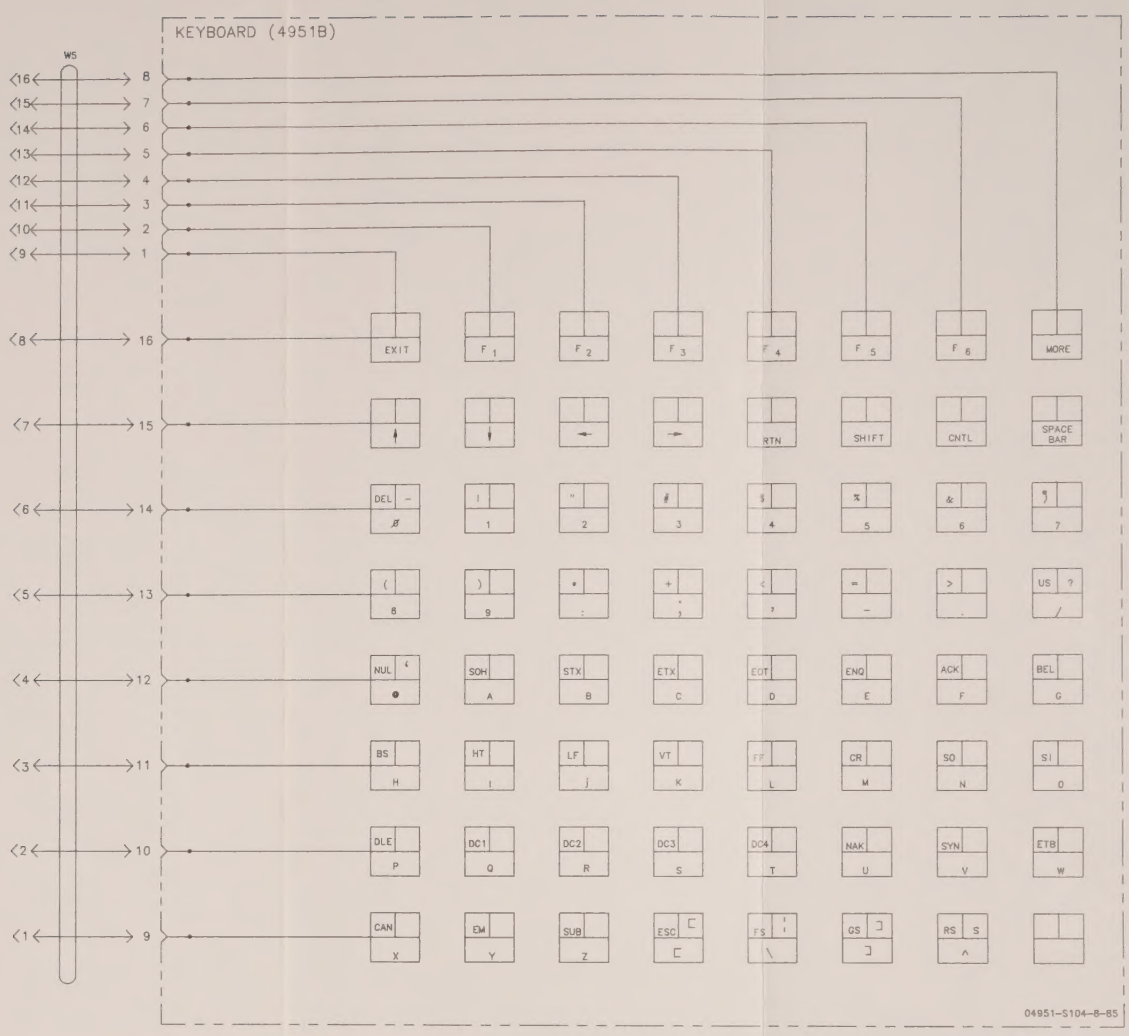


Figure 8-3. Character Cell



8

Figure 8-31. Keyboard Diagram

Figure 8-32. A3 Tape Board Component Locator

c. A1U405

pin 15 3 Vp-p with a .75 V DC offset

d. A1U600

pin 5 2.5 VDC
pin 13 5 Vp-p with no DC offset
pin 14 12 Vp-p centered about a DC zero reference

6. Assume that the DTR MARK LED fails to light. Look for the following voltages.

a. A1U606

pin 2 1 Vp-p with zero DC offset
pin 4 6 Vp-p with 1 V DC offset
pin 5 3 VDC reference

b. A1U705

pin 16 5 Vp-p with 1 V DC offset

7. Check the SPACE LED by connecting the MARK/SPACE test point to the +SOURCE.

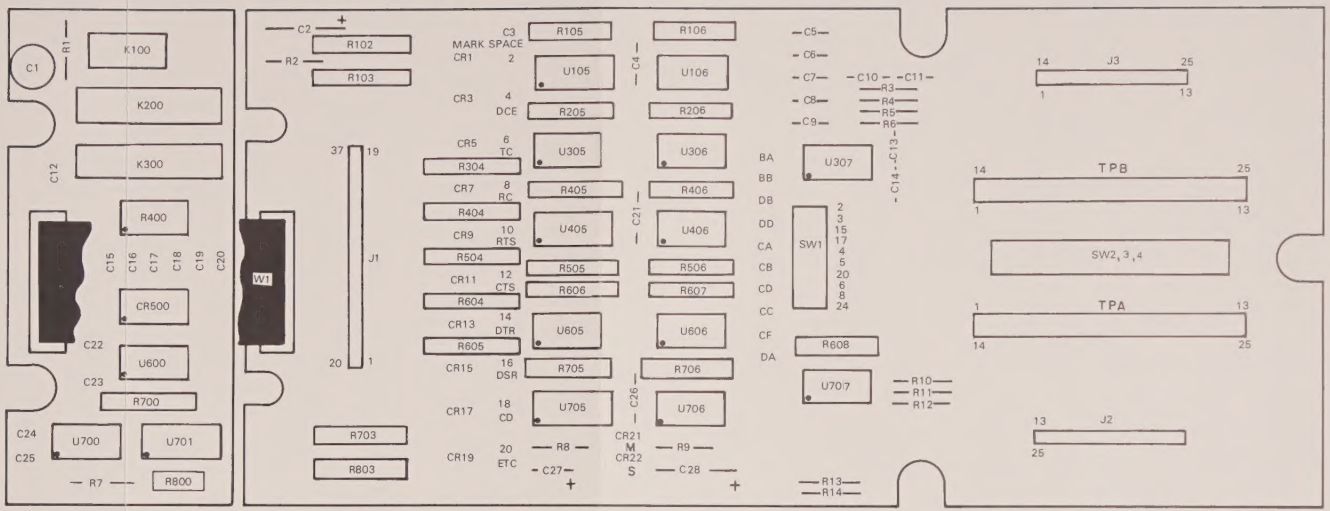
8. Check the MARK LED by connecting the MARK/SPACE test point to the SOURCE.

E-23. Troubleshooting Hints

1. The inputs to A1U600 and A1U700 should be at TTL levels (between 0 and +5 volts).

2. The outputs from A1U600 and A1U700 should be RS-232C levels (+-12 V).

3. The inputs and outputs of all other circuits should be at TTL levels. Check for correct amplitudes and pulsing signals as shown in the examples in sections E-20 steps 4 and 5 and E-22 step 5.



18179-60001 10-85

Figure E-5. HP 18179A Component Locator

SECTION IV
PERFORMANCE VERIFICATION

4-1. INTRODUCTION

Each time the HP 4951 is powered on, the Performance Verification tests are run. The tests completed in about 10 seconds and the internal circuits of the instrument do not have to be accessed the operator. If the HP 4951 fails any of the tests, send the instrument to an authorized HP Repair Ce or refer to the Service Section. When the Performance Verification tests are complete and if there are failures, the Top Level Menu is displayed.

Figure 4-1 is a flowchart describing the Performance Verification tests done at instrument turn on. A the automatic test sequence, the operator may manually enter and perform tests for the Interface Po the Keyboard or begin using the HP 4951. When installed, Option 001 (Tape Board) is automatically te at power on. Tape board failures are not displayed.

4-2. EQUIPMENT REQUIRED

No equipment is required to perform the Performance Verification tests.

4-3. TEST RECORD

Test results and component failures may be recorded on the test record located at the end of this sec Test results should be used for comparison during maintenance or troubleshooting.

4-4. PERFORMANCE VERIFICATION TESTS

This test sequence verifies functional operation of 95% of the HP 4951 Protocol Analyzer. There ar parts to the automatic test sequence. To begin testing, turn on the HP 4951. The tests outlined in T 4-1 are automatically performed. The operator may then manually select the Keyboard test (parag 4-7) or the Interface Pod test (paragraph 4-8), or start using the Protocol Analyzer.

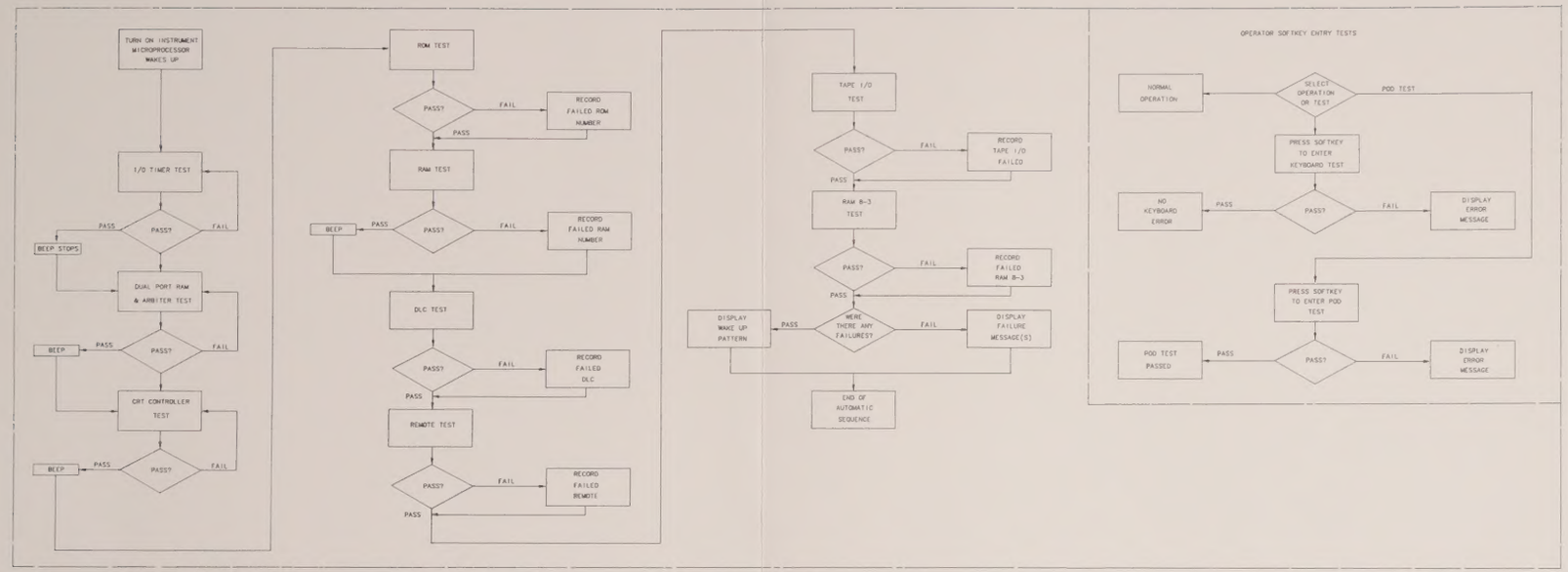


Figure 4-1. Performance Verification Flowchart

Table 4-1. Failure Display

TEST	FAILURES	# OF TESTS
ROM 2	00	
ROM 8-1	00	
ROM 8-2	00	
RAM 2	00	
RAM 6	00	
RAM 8	00	
RAM A	00	
RAM C	00	
RAM E	00	
DLC	00	
REMOTE	00	
TAPE	00	
RAM 8-3	00	

Number of tests = (total number of tests performed)

4-5. PERFORMANCE VERIFICATION FLOWCHART

The flowchart in Figure 4-1 describes the Performance Verification tests. The tests are automatically performed when the instrument is turned on. After the Performance Verification tests are finished, there are two optional tests that may be entered by the operator.

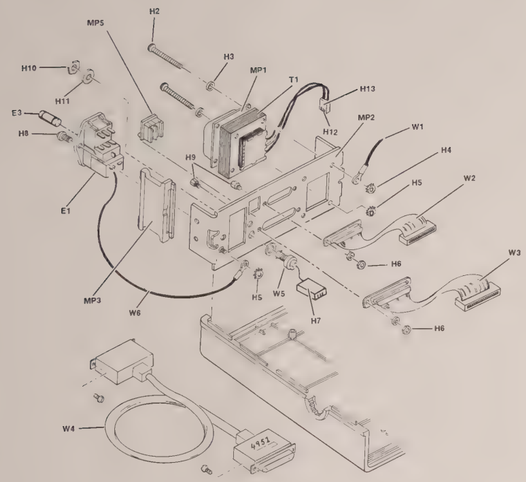


Figure 6-2. Real Panel Assembly Exploded View

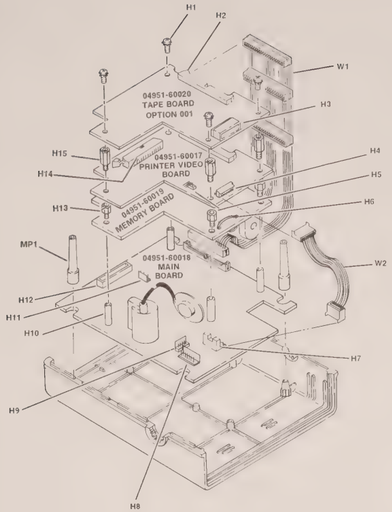


Figure 6-3. Internal Assemblies Exploded View

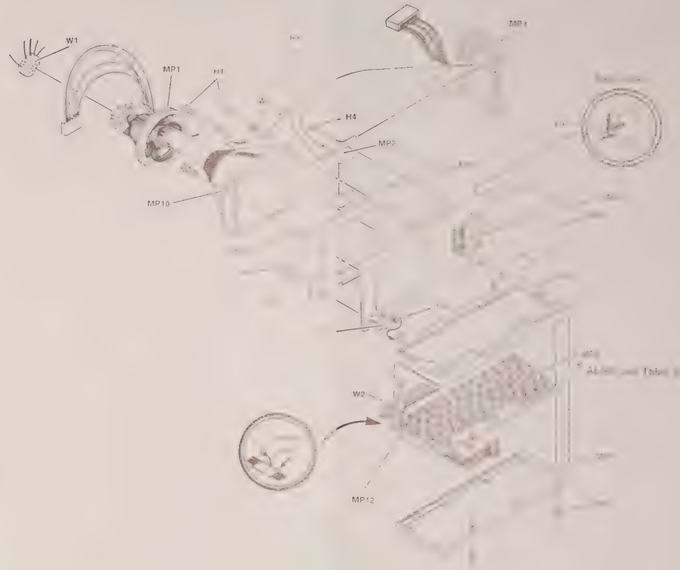


Figure 6-4. Front Panel Assembly Exploded View

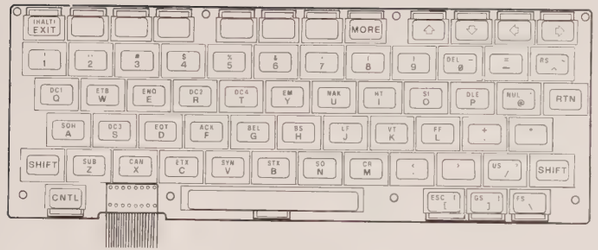


Figure 6-5. Keyboard Exploded View

Table 6-7. Keyboard Keycaps

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	5041-6701	3	1	KEY CAP, PEARL GRAY	28480	5041-6701
2"	5041-6702	4	1	KEY CAP, PEARL GRAY	28480	5041-6702
3 #1	5041-6703	5	1	KEY CAP, PEARL GRAY	28480	5041-6703
4 $	5041-6704	6	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
5 %	5041-6705	7	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
6 &	5041-6706	8	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
7 '	5041-6707	9	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
8 (	5041-6708	0	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
9)	5041-6709	1	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
CODE	5041-6710	4	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
ASCII	5041-6711	5	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
BAUD	5041-6712	6	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
SETUP	5041-6713	7	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
DEL	5041-6714	8	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
LOCAL	5041-6715	9	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
PAGE	5041-6716	0	1	KEY CAP, PEARL GRAY	[illegible]	[illegible]
BEL	5041-6717	1	1	KEY CAP, PEARL GRAY	28480	5041-6717
BS	5041-6718	2	1	KEY CAP, PEARL GRAY	28480	5041-6718
TAB	5041-6719	3	1	KEY CAP, PEARL GRAY	28480	5041-6719
LF	5041-6720	6	1	KEY CAP, PEARL GRAY	28480	5041-6720
VT	5041-6721	7	1	KEY CAP, PEARL GRAY	28480	5041-6721
FF	5041-6722	8	1	KEY CAP, PEARL GRAY	28480	5041-6722
RECR	5041-6723	9	1	KEY CAP, PEARL GRAY	28480	5041-6723
NUSO	5041-6724	0	1	KEY CAP, PEARL GRAY	28480	5041-6724
SOH	5041-6725	1	1	KEY CAP, PEARL GRAY	28480	5041-6725
P.DLE	5041-6726	2	1	KEY CAP, PEARL GRAY	28480	5041-6726
Q.DC1	5041-6727	3	1	KEY CAP, PEARL GRAY	28480	5041-6727
R.DC2	5041-6728	4	1	KEY CAP, PEARL GRAY	28480	5041-6728
S.DC3	5041-6729	5	1	KEY CAP, PEARL GRAY	28480	5041-6729
T.DC4	5041-6730	6	1	KEY CAP, PEARL GRAY	28480	5041-6730
U.NAK	5041-6731	7	1	KEY CAP, PEARL GRAY	28480	5041-6731
V.SYN	5041-6732	8	1	KEY CAP, PEARL GRAY		
W.ETB	5041-6733	9	1	KEY CAP, PEARL GRAY		
X.CAN	5041-6734	0	1	KEY CAP, PEARL GRAY		
Y.EM	5041-6735	1	1	KEY CAP, PEARL GRAY		
Z.SUB	5041-6736	4	1	KEY CAP, PEARL GRAY		
[ESC	5041-6737	5	1	KEY CAP, PEARL GRAY		
\ FS	5041-6738	6	1	KEY CAP, PEARL GRAY		
@ NUL	5041-6739	7	1	KEY CAP, PEARL GRAY		
RTN	5041-6740	9	1	KEY CAP, PEARL GRAY		
~ ^	5041-6741	1	1	KEY CAP, PEARL GRAY		
_ "	5041-6742	2	1	KEY CAP, PEARL GRAY		
shift	5041-6743	3	2	KEY CAP, PEARL GRAY		
< ,	5041-6744	4	1	KEY CAP, PEARL GRAY		
> .	5041-6745	5	1	KEY CAP, PEARL GRAY		
US ? /	5042-6746	6	1	KEY CAP, PEARL GRAY		
SPACE BAR	5040-4461	0	1	KEY CAP, PEARL GRAY		
EXIT(HALT)	5040-4462	1	1	KEY CAP, PEARL GRAY		
MORE	5040-4463	2	1	KEY CAP, PEARL GRAY		
(up arrow)	5040-4494	3	1	KEY CAP, PEARL GRAY		
(dn arrow)	5040-4495	4	1	KEY CAP, PEARL GRAY		
(lf arrow)	5040-4496	5	1	KEY CAP, PEARL GRAY		
(rt arrow)	5040-4497	6	1	KEY CAP, PEARL GRAY		
(ESC,[	5040-4498	7	1	KEY CAP, PEARL GRAY		
(GS,]	5040-4499	8	1	KEY CAP, PEARL GRAY		
(FS,\	5040-4490	9	1	KEY CAP, PEARL GRAY		
CNTL	5040-4491	2	1	KEY CAP, PEARL GRAY		
(BLANK)	5040-4492	3	6	KEY CAP, PEARL GRAY		
MPB	04951-62615	7	1	KEYBOARD		

8-12. MAIN BOARD

8-13. Power Supply

Incoming power is transformed from 60/50 Hz to approximately 36 volts AC. The fullwave is rectified and filtered to produce a 24 volt working voltage. The voltage goes to both the switching and control circuits. The switching circuit chops the signal. The chopped signal is transformed, rectified, and filtered to +12 volts, -12 volts, and +5 volts, the supply voltages for the HP 4951.

24 and 12 volts are applied to the controller from the filter and series regulator. These voltages start up the controller and produce an output square wave of 100 KHz. The square wave is applied to the switching circuit to control the switching rate.

The core reset line from the AC-to-DC circuitry indicates to the controller if the core of the transformer is magnitized and whether or not it has reset. If the core is not completely reset, the transistor which chops the 24 volts DC is turned off to prevent the transformer from saturating. The control circuitry opens or closes the 100 KHz switch and checks for error conditions (over or under voltage). If the 5 volt rail falls below 4.75 volts, a non-maskable interrupt (NMI) is sent to the CPU. The NMI disables RAM to prevent any loss of data.

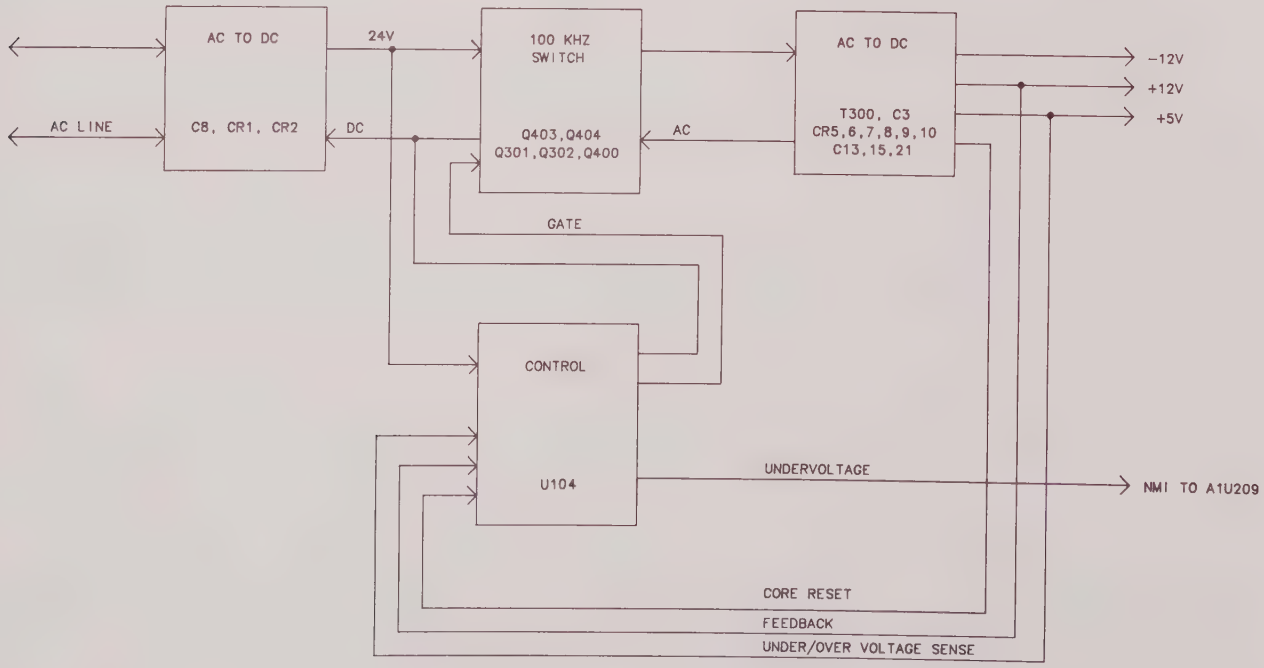


Figure 8-2. Power Supply Block Diagram

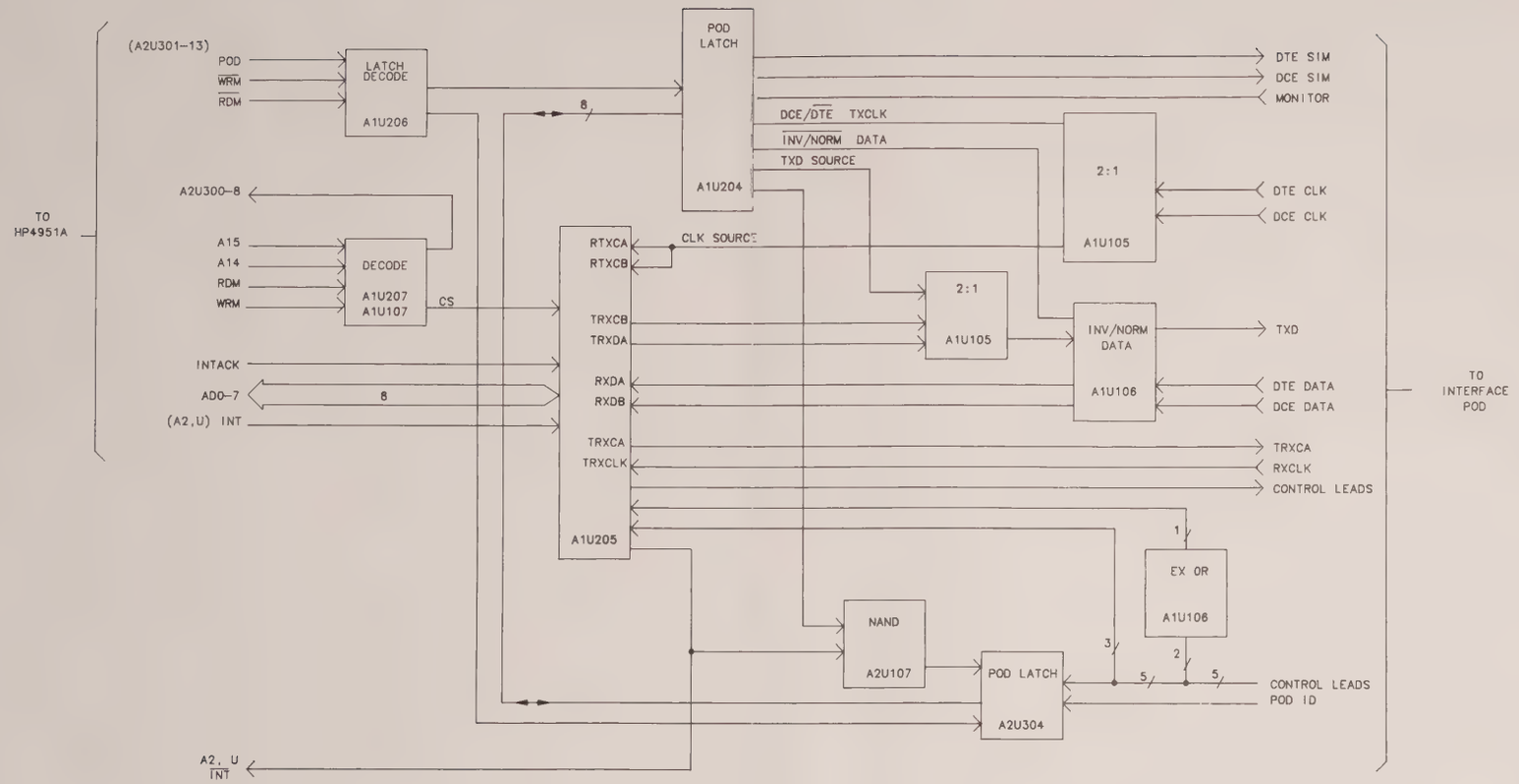


Figure 8-4. DLC Block Diagram

8-14. CPU

The CPU is an NSC800 8-bit microprocessor. It uses a multiplexed data address bus. The 16 bit address bus is divided into a high order 8-bit address bus (A8-A15) and the low order 8-bits are AD0-AD07. The lower 8-bits are multiplexed address/data bus that handles bit 0-7 of the address and bits 0-7 of the data bus. Outputs ALE, RD and WR determine when a valid address/data is present on the bus. When ALE goes from high to low, there is a valid address on the bus (AD0-7). When the RD line goes true (logic level 0) on the trailing edge of the RD strobe, data is input into the CPU. When the WR line goes true (logic level 0), valid data is output from the CPU.

The clock output has a frequency of 4 MHz which is derived from a crystal of 8 MHz. This clock is used as the system clock for the HP 4951. The CPU has one non-maskable interrupt (NMI) which is asserted when the power supply goes below 4.75 volts. There are four maskable interrupts: RSTA, RSTB, RSTC and INTR. RSTA is the interrupt line from the Tic Clock which causes the upper eight bits of real time clock to be incremented. RSTB is a soft key interrupt. RSTC is an interrupt from the processor on the Tape Board.

INTR is an interrupt request from the Data Line Controller (DLC). BREQ goes low when the tape processor requests use of the main bus for a Direct Memory Transfer (DMA) operation. The CPU acknowledges this request via BACK. The IO/M output is the means of identifying whether the CPU is addressing memory or an I/O port. INTACK allows the DLC to put its interrupt vector onto the Address/Data Bus, which the CPU uses to decide what task to perform (8 bits). RESET OUT causes all I/O ports to go to their start condition.

8-15. Data Link Control (DLC)

The Data Link Control (DLC) is an I/O address circuit. It controls the protocol and allows the HP 4951 software to transmit and receive data from the device under test.

Latches

The latches (U204 and U304) set up the operating mode of the Interface [illegible] latched between the HP 4951 and the Interface Pod by U204. Control [illegible] determine the mode operation and multiplexer (U105) to gate in the selected clock source.

Latch Decode

The latch decode enables the latch to receive information from the HP 4951 to set up the operating mode through U304.

Pod Latches

The pod latches configure the Interface Pod and the DLC for the application selected by the operator. When MIL-188C is selected, the INV/NORM data line goes high. The Interface Pod ID and the status of the control leads are latched into U304 to be read by the software any time there is a change.

8-24. MEMORY BOARD

The A2 board consists of an I/O Port (I/O Timer), Tic Clock Timer, I/O Decode, Memory Decode, and the Memory used by the CPU and tape processor.

8-25. I/O Timer

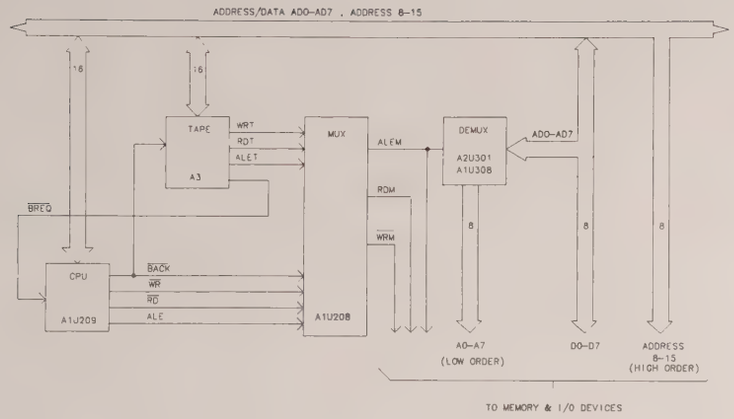
The I/O timer provides clocks and selects the I/O device for incoming and outgoing data from the HP 4951. It processes information from the CPU and generates clocks and interrupts. When the CPU sends an address on the address/data bus, the I/O timer puts out data or brings data from the specified I/O devices. TI out generates an interrupt to the CPU thru U503, PC1, and PC2. The interrupts go to the keyboard interrupt/debounce and interrupt circuits. PC3 drives the beeper by turning U504 on or off. A 12 volt square wave activates the beeper. PAO 4 and 6 are used with A13, 14, and 15 from the CPU to decode the memory pages as required by the CPU thru U208 and U207.

I/O Decode

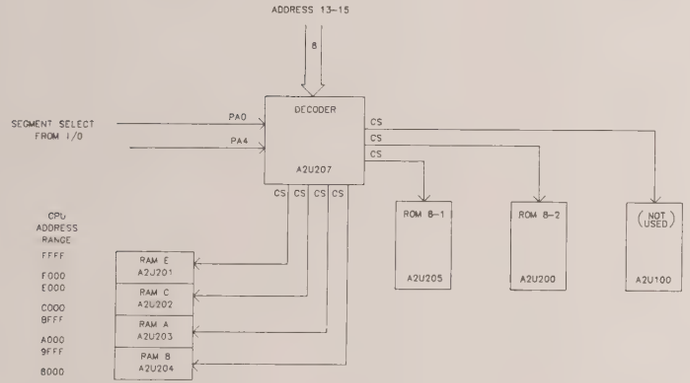
The I/O decoder (U302) is addressed by the CPU through control lines A11-A15. It decodes the address of the I/O device to be addressed and the operation (read/write) to be performed.

Tick Clock Circuitry

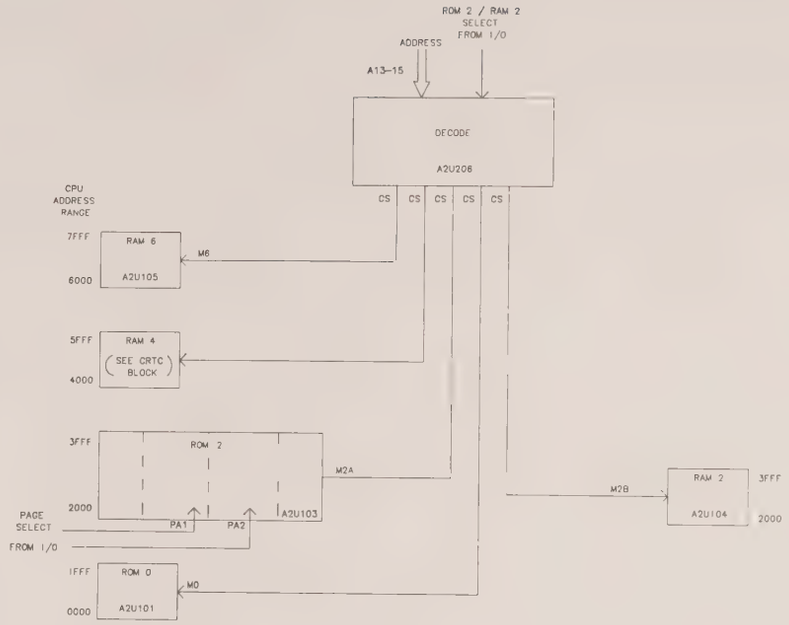
The tick clock is a counter which provides timing information for data coming into the HP 4951. The tick clock sends an interrupt to the CPU every 64 counts to update timing information in the capture buffer.



(address decode)



(Upper half of memory)



(lower half of memory)

Figure 8-8. Memory Block Diagram

8-26. Memory

There are 64 Kbytes of linear address space in the HP 4951. To accomodate more memory, the address space is segmented into upper and lower halves. Addresses greater than 8000H are contained in the upper half of memory and addresses less than 7FFFH are contained in the lower half of memory.

The memory circuitry can be divided into three sections: Address Decode, upper half of memory, and lower half of memory. When address or data enters the address multiplexer circuitry, the address is demultiplexed and sent to memory. Data goes directly to the memory and I/O devices.

Address Multiplexer

The tape and CPU address memory through the multiplexed 16 bit Address/Data Bus. The CPU selects the device that will have access to memory via BACK. When BACK is low, the tape has access and when it is high the CPU has access. The read (RD) and write (WR) lines go through the multiplexer to memory and I/O devices. ALE (Address Latch Enable) is the control signal which demultiplexes the lower eight bits of address.

Upper Half of Memory

The upper half of memory contains 32 Kbytes of RAM, two blocks of 32 Kbytes of ROM, and one block of RAM memory. Address lines 13-15 and segment lines from the I/O circuitry are input to the decoder. These lines determine which segment of memory will be addressed.

Lower Half of Memory

The lower half of memory contains one block with 32 Kbytes of ROM, one 8 kbyte block of ROM three 8 Kbyte blocks of RAM. ROM 1 and RAM 2 are at address 2000H. ROM 2 is logically divided into four 8 K pages.

From the decoder determine whether ROM 2 or RAM 2 is selected. Page select lines PA1 and PA2 select the correct page of memory in ROM. RAM 4 is implemented as a dual port memory device to provide the CRT controller circuitry access to display information.

Figure 8-7. Memory Map

8-27. PRINTER/VIDEO INTERFACE BOARD

The Printer/Video Interface Board provides the HP 4951 with a second serial I/O port. It allows an external monitor or external printer to be connected to the HP 4951. The Printer/Video Interface Board has two independent circuits: the remote/printer and external video.

Remote/Printer Circuit

The main processor is connected to the remote/printer circuit through five control lines and an address/data bus. The remote/printer circuit toggles an interrupt line to the microprocessor when there is information to be read. The remote/printer circuit shifts the TTL level information from the HP 4951 to RS-232C level to print. It can also shift RS-232C level information to TTL.

The address/data bus goes to a latch which controls the baud rate generator circuit and to the asynchronous communications interface adapter (ACIA). The signal output from the latch controls five different functions of the remote/printer circuit:

sets the selected output baud rate,
sends the DTR signal to the output stage,
enables the output stage,
disables the output stage,
and sends a clock to the loopback multiplexer.

The baud rates are created by a crystal controlled bit rate generator and the outputs are applied to an eight-to-one multiplexer. The output of the multiplexer is applied to the ACIA and is also as the data transmit/receive clock.

The microprocessor uses the ACIA as an I/O port to control the transmission and reception of the asynchronous data to and from the HP 4951. The ACIA converts parallel data from the memory of the HP 4951 to serial format and incoming data from serial to parallel. Information is transferred to and from the ACIA across the address/data bus. The read and write lines from the microprocessor control the direction of the flow of data through the ACIA. The read and write lines are also fed into a NAND gate. The output creates the ACIA clock signal.

Data from the ACIA is converted from TTL levels to RS-232C levels through the logic level shifting circuitry. Inputs to the HP 4951 are converted from RS-232C to TTL levels through the level shifting circuitry. After the inputs are level shifted, the signal goes through the loopback multiplexer to the ACIA.

The loop back multiplexer has two functions. First, it routes the input data to the ACIA. Second, it loops the TXD, RTS, and DTR signals back to the ACIA during the self test mode. This provides a complete self test of the remote/printer circuit with the exception of the output stages.

Important Signals

In the HP 4951 I/O map, select line X6 goes low during inputs to location 30H through 37H. The remote/video capabilities reside in the I/O space at locations 30H and 31H (latch) and 32H and 33H (ACIA).

Pin 1 of U208 is the output enable (OE) line of the latch. To turn the latch off, pull pin 1 to al logic 1. The technician can then manually select all combinations of the latch.

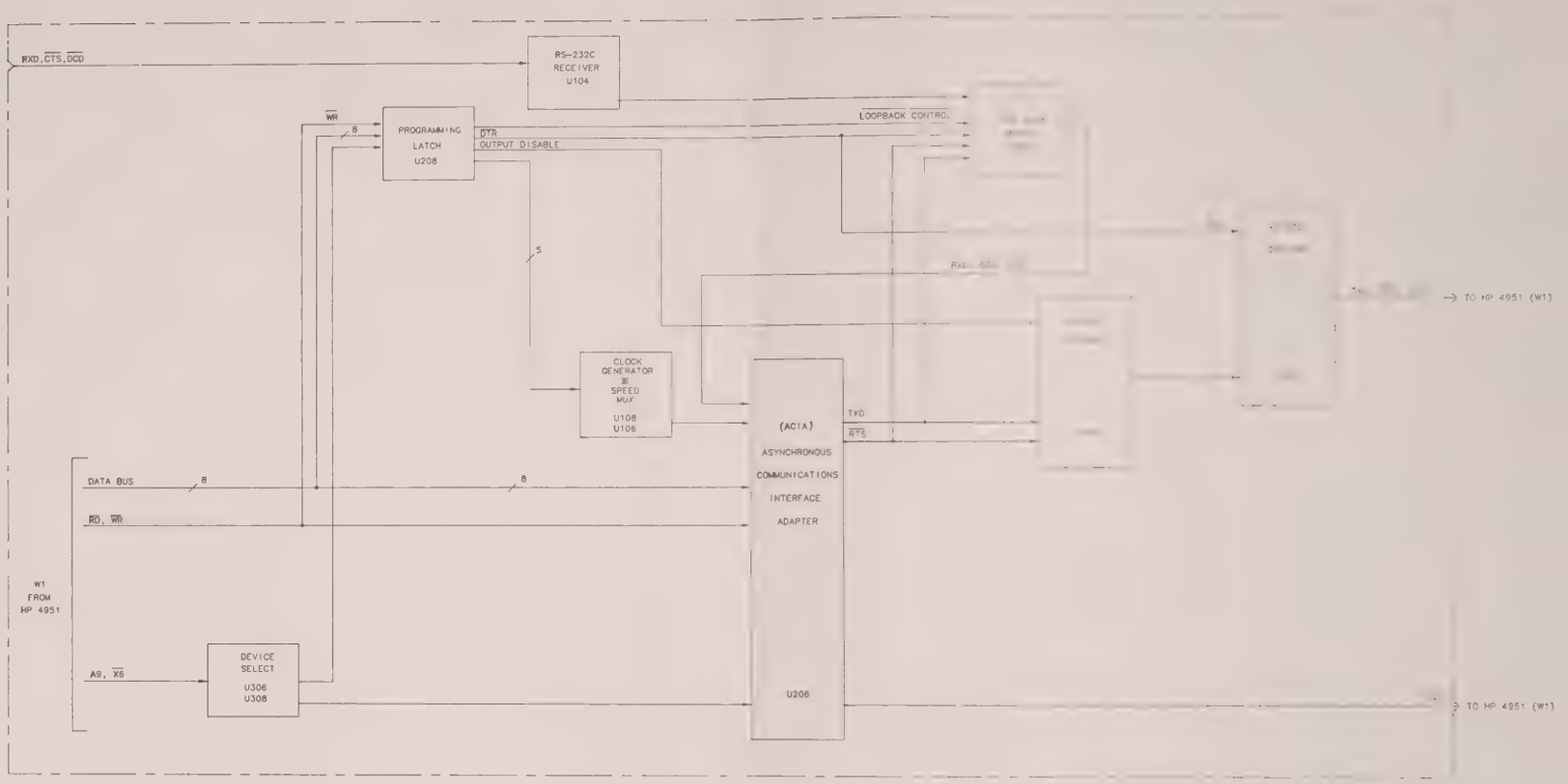


Figure 8-9. Printer/Video Block Diagram

8-28. External Video

The external video circuit allows an external monitor to be connected to the HP 4951. The monitor displays only the information on the HP 4951 CRT. The external video circuit is compatible with EIA Standard RS-170.

There are five signals input to the video circuit: horizontal sync, vertical sync, character clock, video and half bright. The horizontal sync, vertical sync, and character clock signals are input to two counter circuits. The counter circuits synchronize and combine these three signals. The combined signal is sent to the output stage as a clock signal.

Inverse video and half bright signals are also applied to the output circuitry. These signals are clocked through NOR gates to a summing junction. The signal is output to a jack on the rear panel through an emitter follower to be used by the external video monitor.

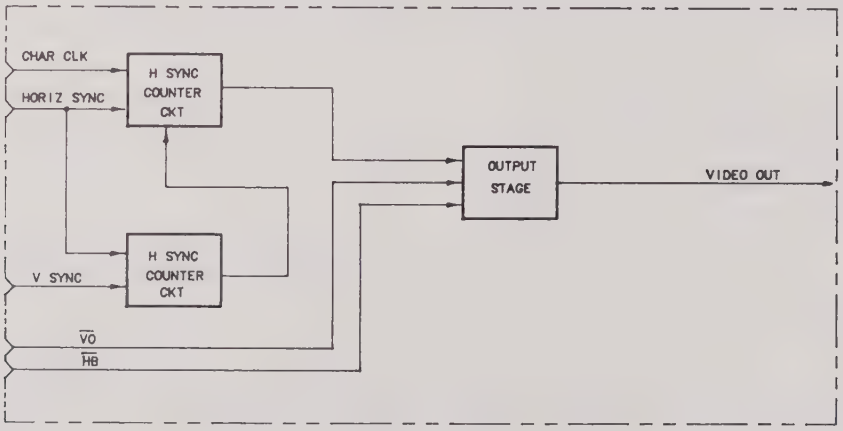


Figure 8-10. Video Interface Block Diagram

8-29. TAPE BOARD (Option 001)

The HP 4951 Tape I/O Board is compatible with the other HP Protocol Analyzers and supports the Standard Interchange Format (SIF) for the DC 100 tapes. It is controlled by a single microcontroller, EPROM, and a state machine. Data transfer is accomplished via DMA (Direct Memory Access) process to keep the overhead on the main processor down. Following is a description of user functions.

Mass Store

The softkey designated "MASS STORE" on the top level menu is the means to access the tape I/O board operations. The operations available to the operator are: "tension, initialize, catalog, load, and store".

Tension

This operation simply will run the tape all the way forward and back again. This relieves the tape stress or slack in a new tape or tapes that have not been used in a long time. This operation is also the only operation that begins by winding the tape forward instead of backward, useful if the tape cartridge is back too far and is in imminent danger of despooling.

Initialize

This operation erases the directory of the existing tape and formats the first 40 inches of the tape for a new directory. It permanently erases the old directory and erases the first 40 inches of track B.

Catalog

The catalog will display all the files on the cartridge currently in the tape transport. The name of the file is displayed (10 characters max), along with the file type (menu only, menus and data or application program), and a user description about the file (16 characters max).

Load (Read)

This operation will load any of the catalogued files into the appropriate memory location in the HP 4951. A menu file fills in the blanks in the "SETUP: screen as well as loads up any simulate or monitor menu that is stored in the particular file. A "MENUS & DATA" file loads the same information as a "MENU" file, along with on capture buffer worth of data. The data stored in the file may be larger than one capture buffer in size, but only one capture buffer can be loaded at a time. An "Application Program" file will load an application program for the user into the HP 4951 for special operations.

Store (Write)

Store will do the same things that "LOAD" will do except from the HP 4951 to the tape.

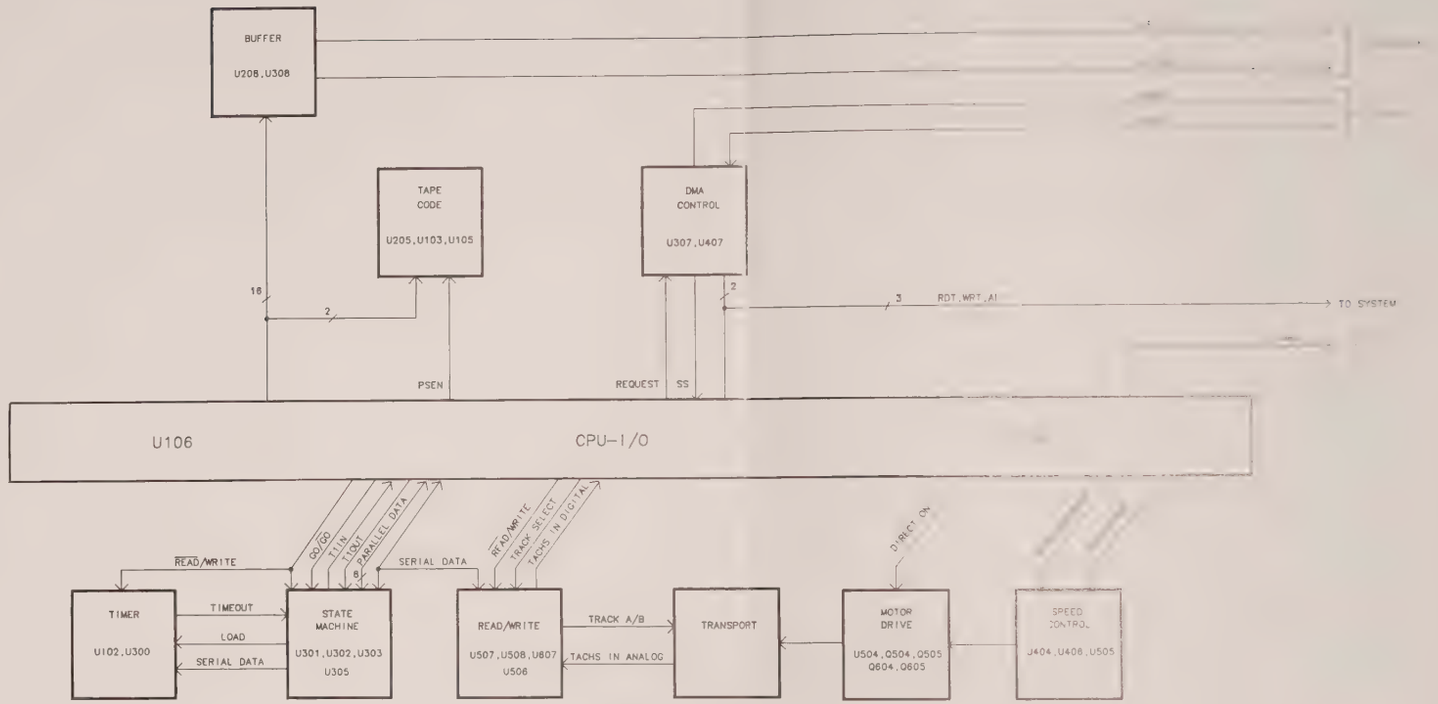


Figure 8-11. Tape Board Block Diagram

8-30. CPU: Micro-controller Functions

The clock frequency is derived from a 6 MHz crystal. The microprocessor divides this by 3 to get a frequency of 2 MHz. This is the clock frequency for the state machine and the I/O Timer. U106 pin 7 (EXT address) is tied to five volts to force all program memory accesses to go to EPROM U103. T1 (pin 39) has as its input the times 1 output of the I/O Timer (pin 5). Port 2 P20-P23 (Bits 0 thru 3) provides the upper four bits of the address bus during OPCODE cycles. The lower 8 bits are D0 thru D7 (pins 12-29). These twelve bits are clocked thru the latches U105 and U205 on the rising edge of the ALE signal. This is the next address for EPROM U103 to output the next instruction to the processor. Port 2 P20-27 (Bit 0-7) supplies the upper 8 bits of any external memory transfers (DMA) to the memory map of the HP 4951.

The functions of the remaining I/O ports are as follows:

Port P10 — This port is an output that is connected to switch E304, pin 3 one of the SA switches. The processor reads this port after power up to determine whether to operate normally or to enter one of three different SA loops.

Port P11 — The other SA switch input.

Port P12 — This port is an output which selects the track on the tape to be used. A logic 1 selects Track A, a logic 0 selects Track B.

Port P13 — This port is an output which determines the direction of the motor. A logic 1 is reverse (REV) and logic 0 is forward (FWD).

Port P14 — This port is an output which enables the state machine (GO).

Port P15 — This port is an output which turns on the state machine (SM ON).

Port P16 — This port is an output. A logic 1 configures the tape head muxes (U507 & U508) to pass data from the tape head to the read amplifier. A logic 0 (7 MA of write current flowing through the tape head) the polarity is dependent upon the state machine U302 pin 15, bit 5.

Port 17 — This port is an output that sets the bus request flip flop (U407) on the rising edge (BREQ).

Port P24 thru P27 — These ports provide the high order 4 bits of the address that the processor can access in the main processors memory space. The high order hex digit of the DMA address.

Write Protect and Cartridge Detect

The write protect and cartridge detect circuits are both micro-switches mounted in the tape transport housing. When there is no cartridge loaded in the housing, the switch is opened and the "CART" signal is pulled to a logic 0 by a resistor (R505) on the tape board. When a cartridge is loaded, the switch is closed and the "CART" signal is a logic 1.

The write protect switch is wired similarly. When the write protect slide on the tape cartridge is in the write protect position, the switch is opened and the write protect signal is to logic 0 by a resistor on the Tape Board. In the record position, the switch is closed and the write protect signal is a logic 1.

There is an infrared LED and phototransistor pair for sensing the speed of the motor. The optical path between the LED and the phototransistor is broken by a grating disk attached to the motor shaft. When the motor has turned enough to move a tape one inch, there have been 968 interruptions in the light beam to the phototransistor. The tach signal is filtered, amplified, and routed to the analog switch.

The current to the infrared LED is controlled by a power FET (Q606) which is controlled by the processor. When the FET is off, there is no current to the hole detect or the tachometer circuits and the motor speed is interpreted as zero. If the reference frequency is also zero, there will be no error signal; hence, no attempt by the motor control loop to alter the motor speed.

The Tick Clock sends an interrupt to the CPU every 64 counts to update timing information in the capture buffer. When the CPU gets this interrupt, it services the Tick Clock and updates the buffer. During normal operation, when information comes in, it is stored in the capture buffer and tagged with timing information.

Shared Interrupt Circuitry

When INT is generated by the I/O Timer, it is synchronized to the rest of the system causing the Tick Clock contents to be latched in. Then the interrupt request is passed on to the CPU.

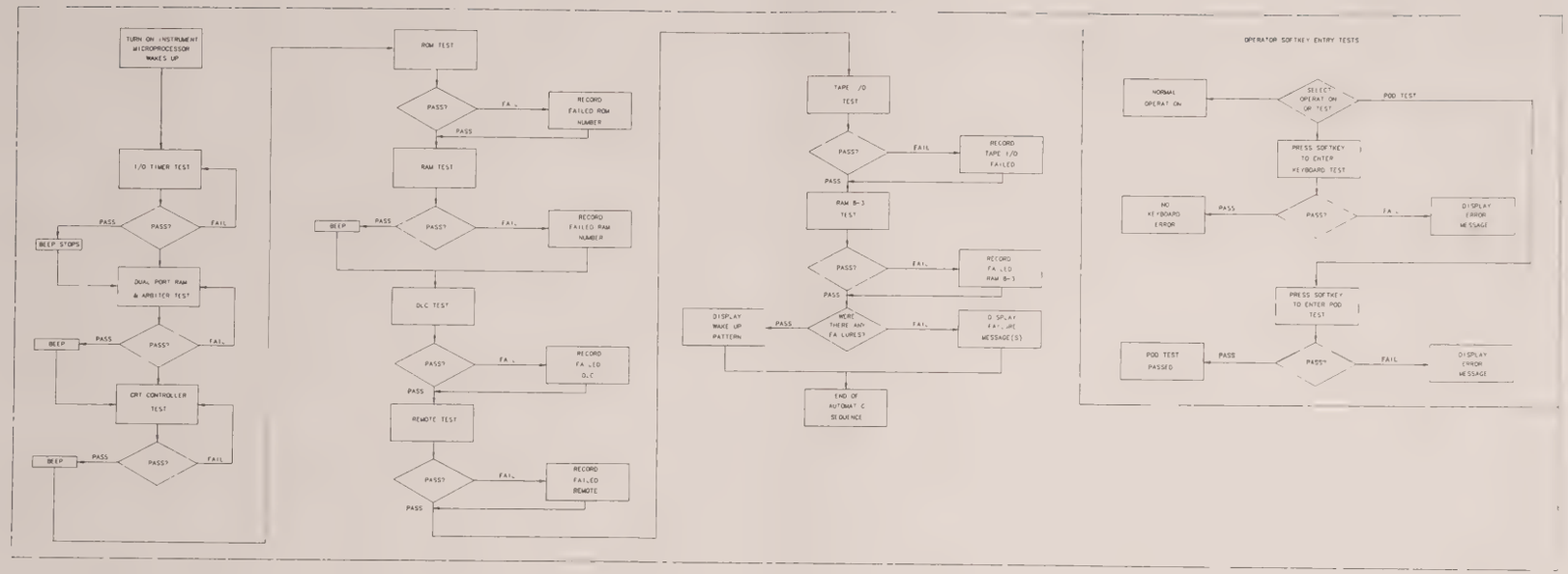


Figure 8-12. Performance Verification Flowchart

8-36. TROUBLESHOOTING

Troubleshooting the HP 4951 is a two part process. Use the results of the Performance Verification tests to identify the circuit with problems. Once the circuit is identified, use the Signature Analysis routines to isolate the problem component level. Table 8-2 illustrates the failure table for the Performance Verification test sequence. Figure 8-12 is the Performance Verification flowchart.

To troubleshoot, perform the Performance Verification tests and note any failures. The test descriptions contain the test failure code, description and troubleshooting procedure.

Table 8-2. Performance Verification Failure Table

TEST	FAILURES	NO. OF TESTS
ROM 2	00	01
ROM 8-1	00	
ROM 8-2	00	
RAM 2	00	
RAM 6	00	
RAM 8-0	00	
RAM A	00	
RAM C	00	
RAM E	00	
DLC	00	
REMOTE	00	
TAPE	00	
RAM 8-3	00	
Number of tests (total number of tests performed)		

8-46. Tape I/O

Test Failure Code

Number of times failed displayed under FAILURES column.

Description

Checks digital circuitry.

Failure Troubleshooting

1. The Tape I/O troubleshooting procedures begin paragraph 8-47. Start at the beginning and complete all procedures.

8-47. RAM 8-3

Test Failure Code

Number of time failed is displayed under FAILURES column.

Description

Verifies operation of A2U100.

Failure Troubleshooting

1. Replace A2U100.

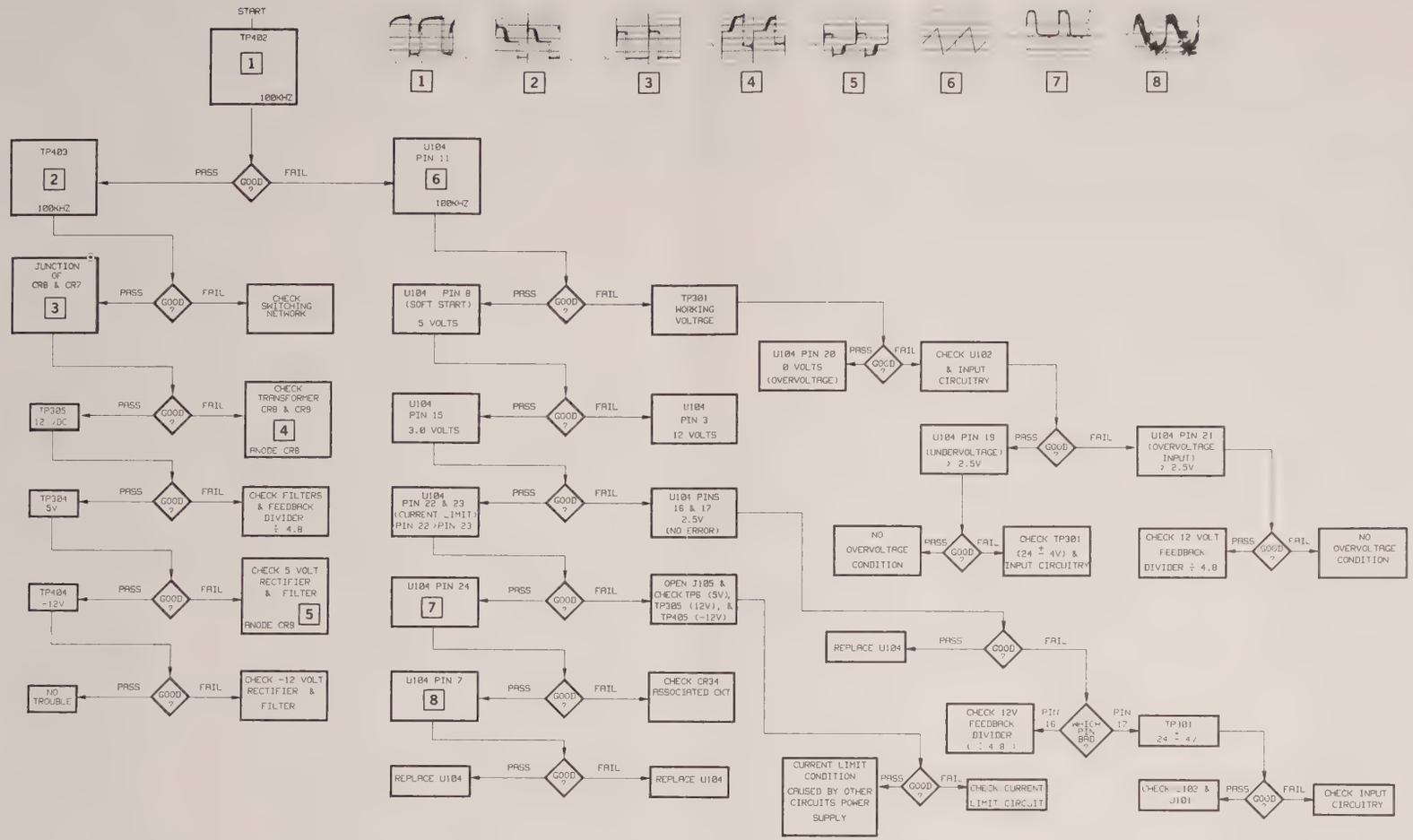


Figure 8-13. Power Supply Troubleshooting Flowchart

8-48. POWER SUPPLY TROUBLESHOOTING

To troubleshoot the Power Supply, work through the flowchart in Figure 8-13.

8-49. TAPE I/O ANALOG TROUBLESHOOTING

Before working through the analog troubleshooting, use the table below to help identify the cause of any error messages that may be displayed.

Table 8-3. Tape Board Error Messages

ERROR MESSAGE	DESCRIPTION
TAPE OUT	The tape is out of the Tape Transport, possibly pulled ou while running
DESPOOL ER	The tape has despooled and must be replaced
PROTECTED	The tape is write protected
CHECKSUM ER	There was a check sum error during the
END OF TAPE ER	The End of Tape (EOT) hole was found on track B
FORMAT ER	The sync word was not found
SYNC ER	The synchronization pattern did not
TAPE SYS ER	There was a Performance Verific verflowed
SERVO ER	The tape speed is wrong
TIME ER	The byte took too long to be read
END OF FILE	Indicates that the read overlapped
FILE FULL	There is no more room to write on

If any of the errors in Table 8-3 are displayed, go to paragraph d Signature Analysis routines. If the Signature Analysis for the Tape I/O 4 to check the analog part of the circuit.

Set Up

1. Insert a cassette tape.
2. Turn on the HP 4951.
3. Enter the simulate program in Table 8-4. "Select" indicates a and press indicates a key with the specified mnemonic.

Table 8-4. Simulate Test for Option 001

Select	SIMULATE
	DTE
	SEND
Type in	SOME MESSAGE
Press	RTN
	EXIT

You should see the Top Level Menu on the screen.

Press	MORE
Select	MASS STORE
	INSERT TAPE
	TENSION

Wait for the tape drive to stop

Select	INIT

A warning should appear on the CRT

Select	EXECUTE

Wait until the tape drive stops

Select	STORE
Type in	a file name of your choosing
Select	EXECUTE

Wait until the tape drive stops

4. If no error messages are displayed in any of the steps in procedure 3, then the analog circuit is 100% tested and working.

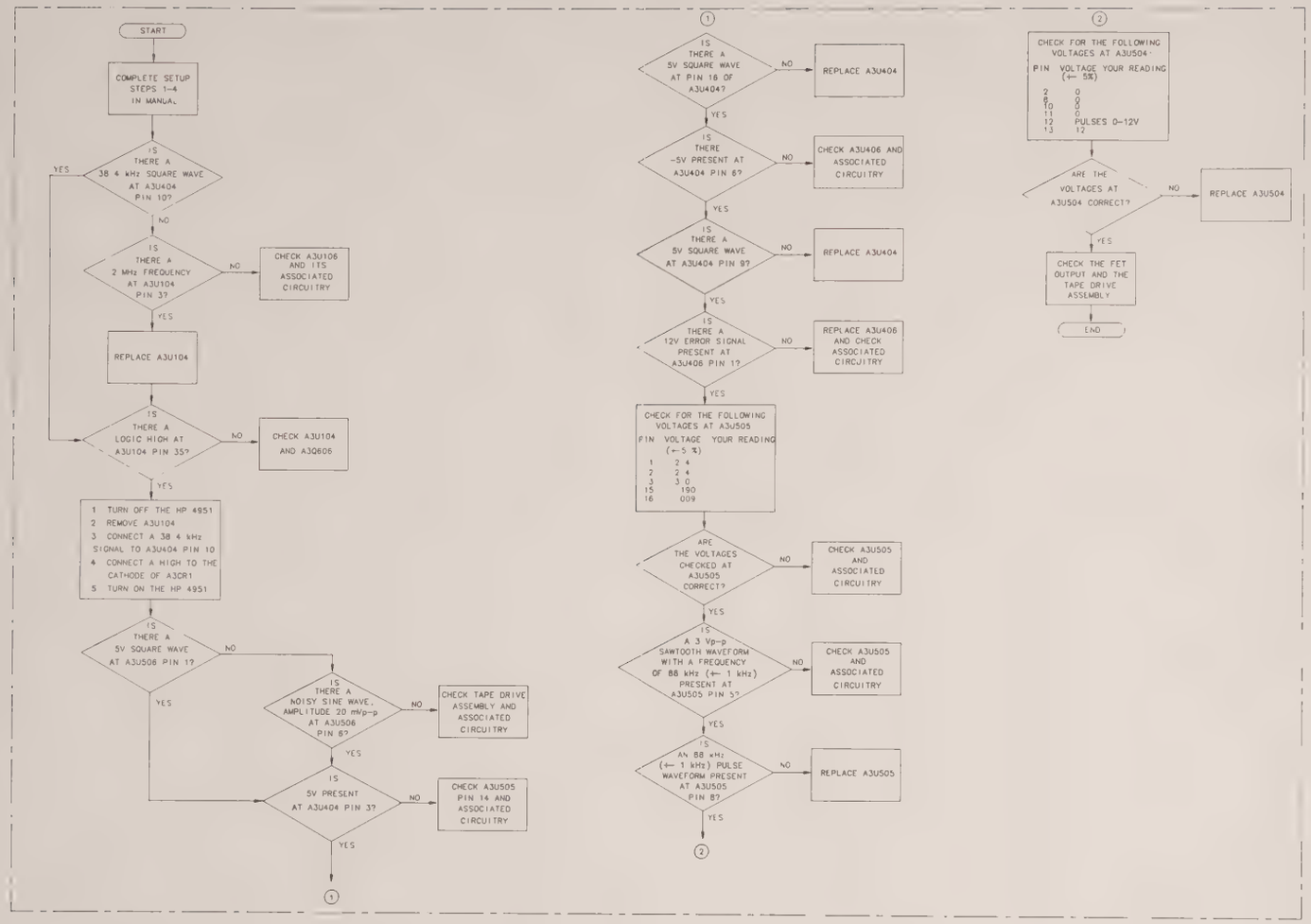


Figure 8-14. The Tape Motor Not Rotating Troubleshooting Flowchart

8-50. Read Amplifier Troubleshooting

Description

Troubleshooting procedure for the Read Amplifier circuitry.

Equipment

3310B Function Generator

Procedure

1. Turn off the HP 4951.
2. For A3E304, set switches 1, 2, and 4 closed and 3 open.
3. Turn on the HP 4951.
4. The wake up menu should be on the display.
5. Check Pin 6 of A3U507 and A3U508, they should be high and low respectively.
6. Pin 10 of A3U507 and A3U508 should be high.
7. Pin 9 of A3U507 and A3U508 should be low.
8. Connect a Function Generator to A3U508 pins 3 and 13. The low side of the Function Generator shold be connected to Pin 3. Check the signals at A3U506 and A3U607 against the waveforms shown on the Tape Board Schematic (11).
9. Set up the Function Generator as follows:

   Function = triangle
   Frequency = 33 kHz at 50 mVp-p

8-51. Motor Speed Control Troubleshooting

Procedure

1. Turn off the HP 4951.
2. Set all switches of A3U304 to closed (DMA)
3. Turn on the HP 4951.
4. The waveforms shown on schematic 11 should be displayed.

Table 8-32. DMA Signature Analysis

LOOP: DMA PCA: A3 Tape Controller
SET UP: Close switches 1, 2, 3, and 4 of A3E304.

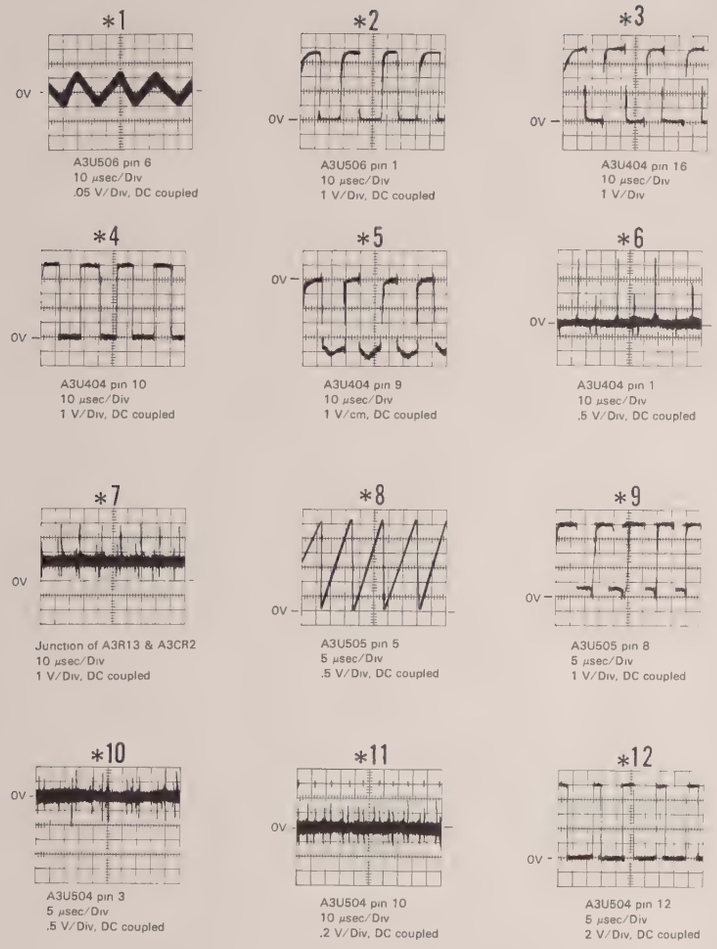
NOTE: Wait approximately 15 seconds for start/stop to toggle. This gives Vh time to set the correct signature.

SIGNATURE	QUAL	
START/STOP	+/-	A3U106 pin 34
QUAL	+	A3U106 pin 33
CLOCK	+	A3U106 pin 1
GROUND		A3U106 pin 20

Vh = 03U9

U307 2 = 03U9
3 = 0000
4 = 03U9
5 = 03U9
6 = 0000
8 = 03U9
10 = 0000
11 = 03U9
12 = 0000
13 = 03U9

U407 3 = 0000
4 = 03U9
5 = 03U9
6 = 0000
8 = 03U9
10 = 03U9 (high)
11 = 03U9
13 = 0000



P/O Figure 8-16. A1 Power Supply Schematic, Waveforms

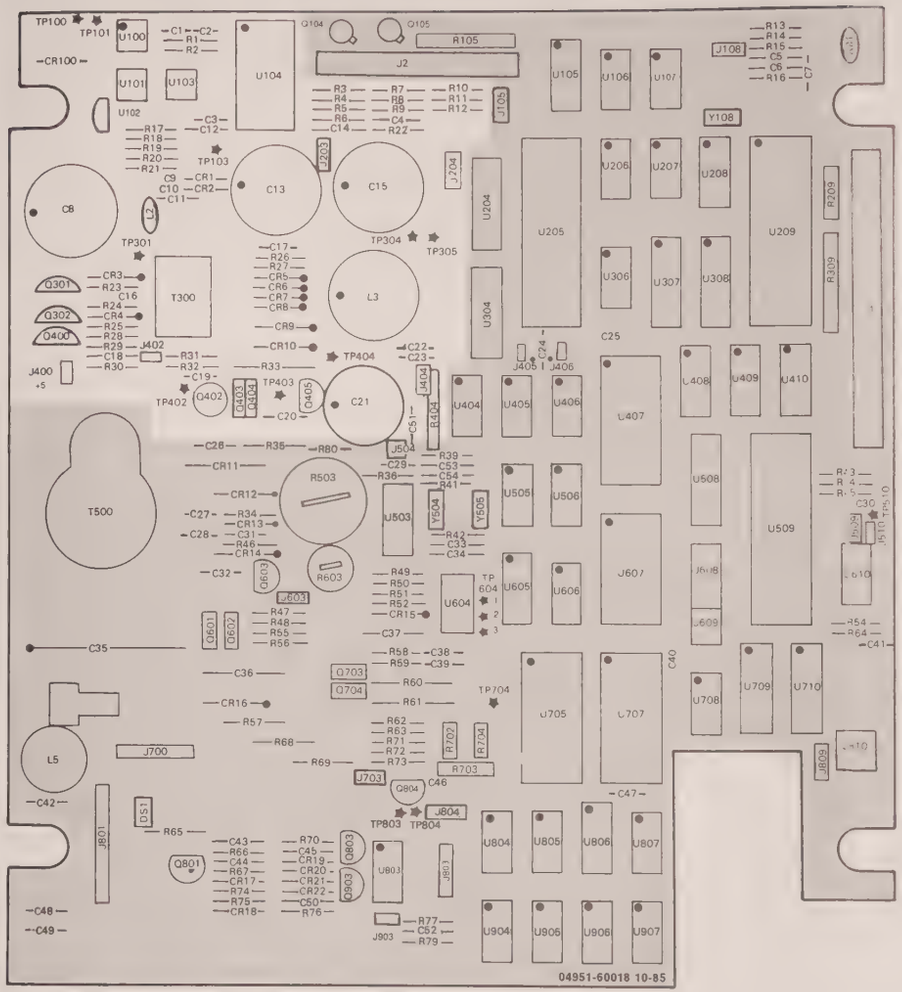
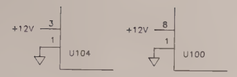
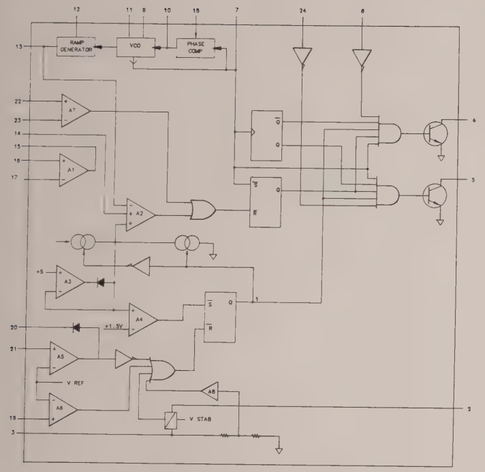


Figure 8-15. A1 Main Board Component Locator



Power and Grounds



U104
Switching Power Supply Controller (AM6301)

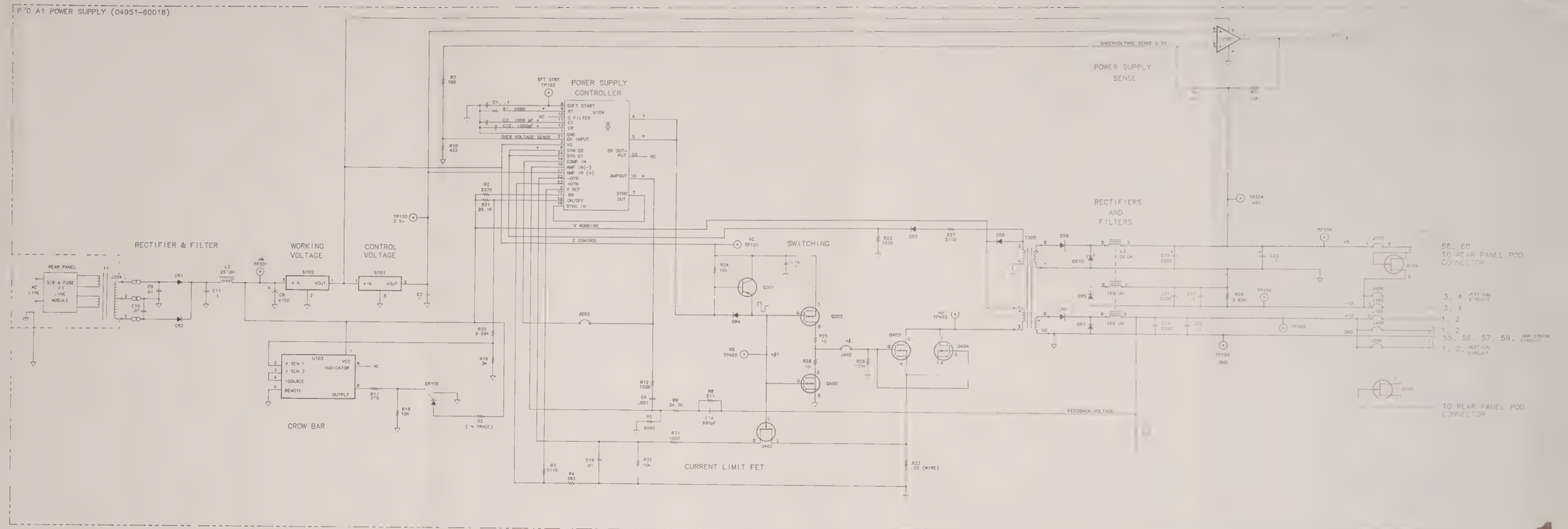


Figure 8-16. A1 Power Supply Schematic

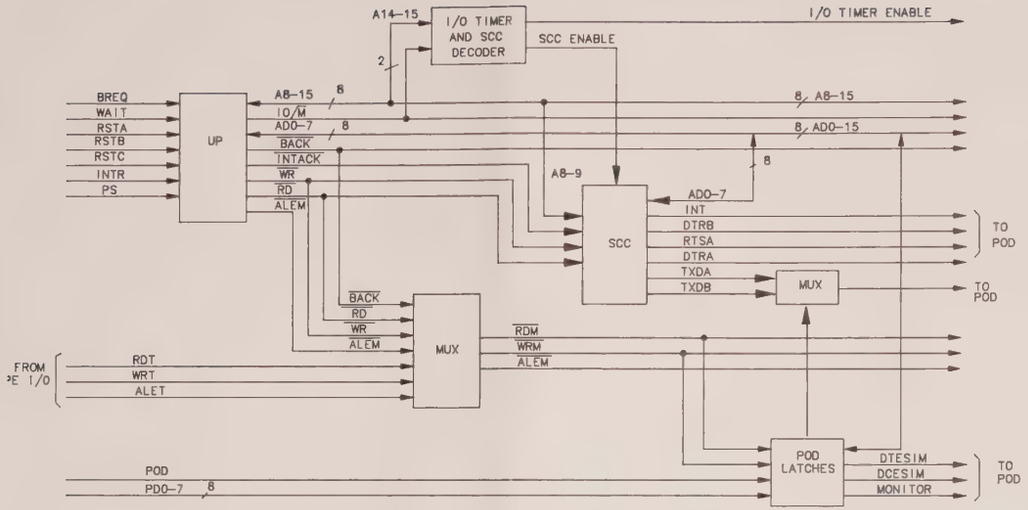
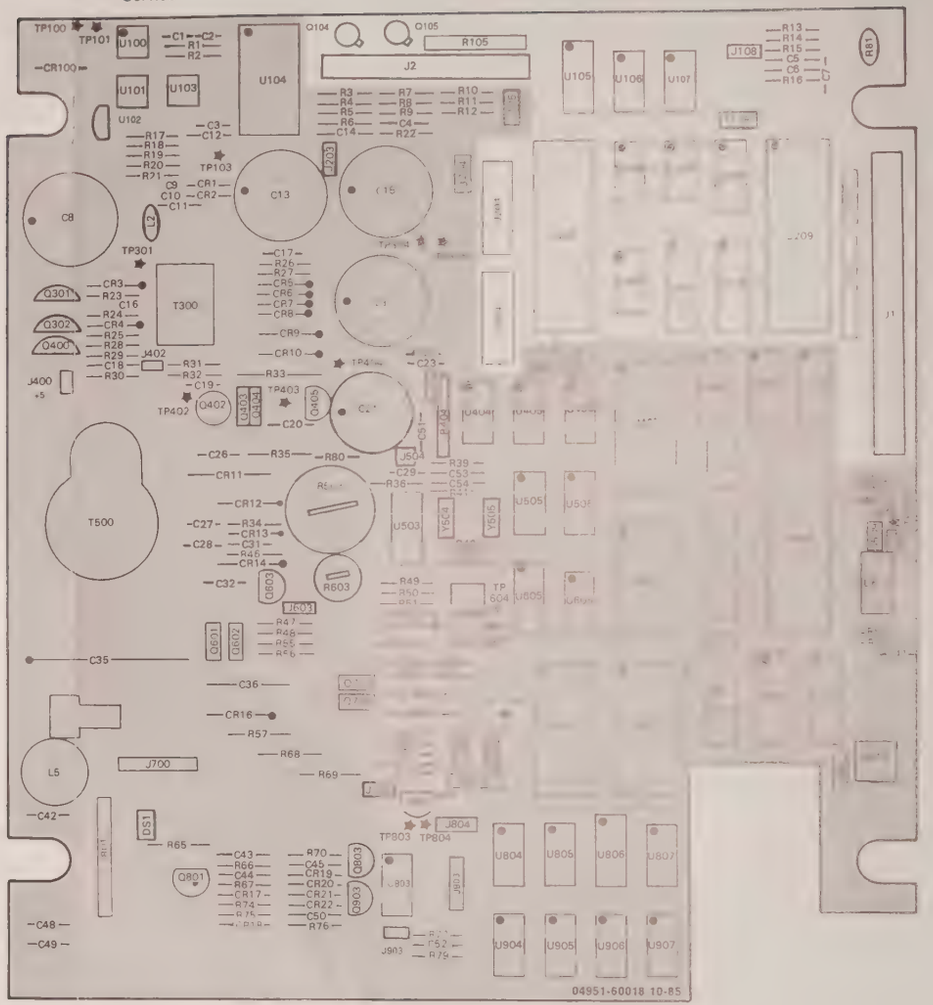
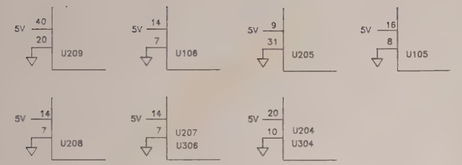


Figure 8-17. CPU and DLC Schematic Block Diagram



A1 Main Board Component Locator



Power and Grounds

CPU CLOCKS

P/O Figure 8-18. A1 CPU and DLC Schematic, Waveforms

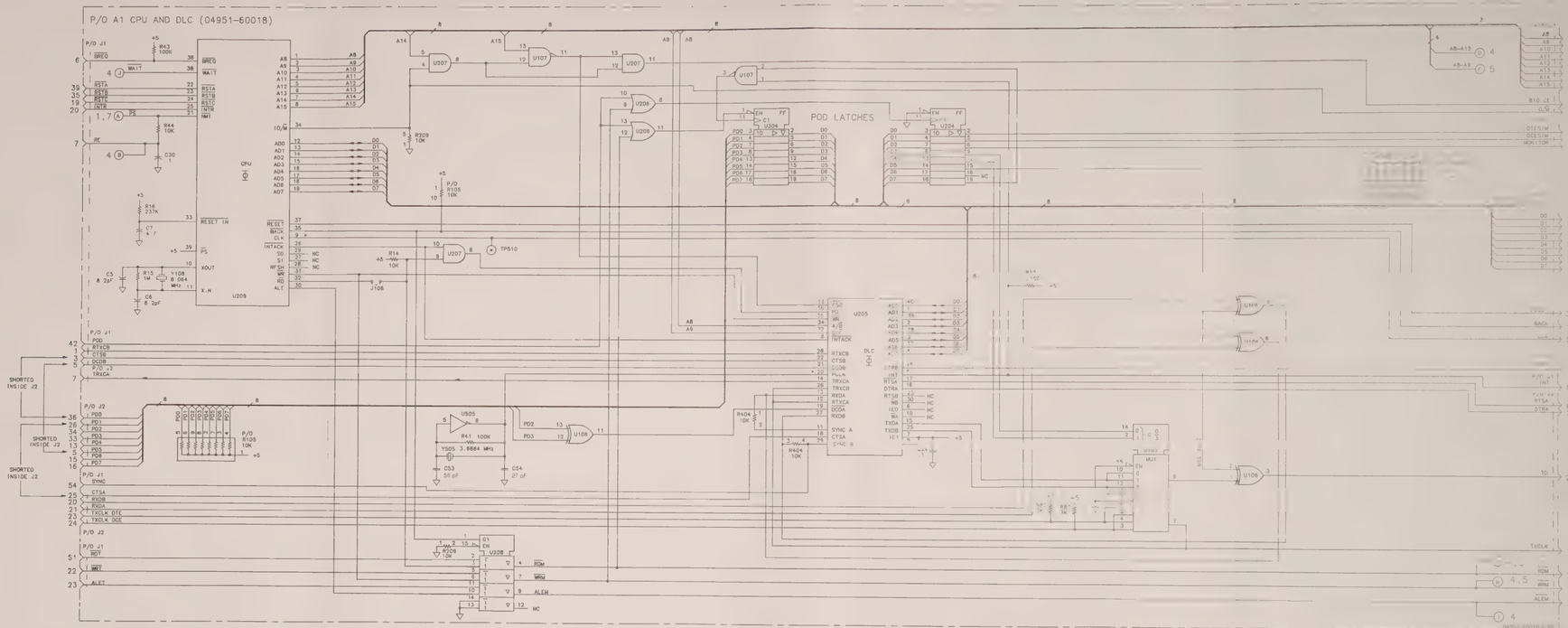


Figure 8-18. A1 CPU and DLC Schematic

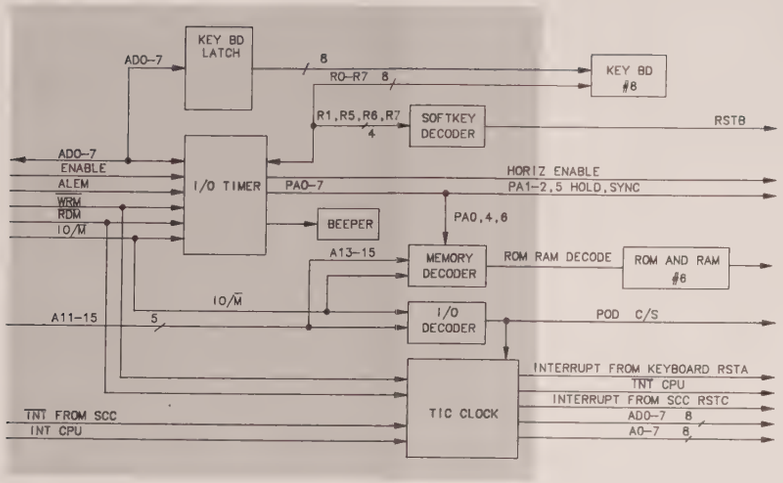
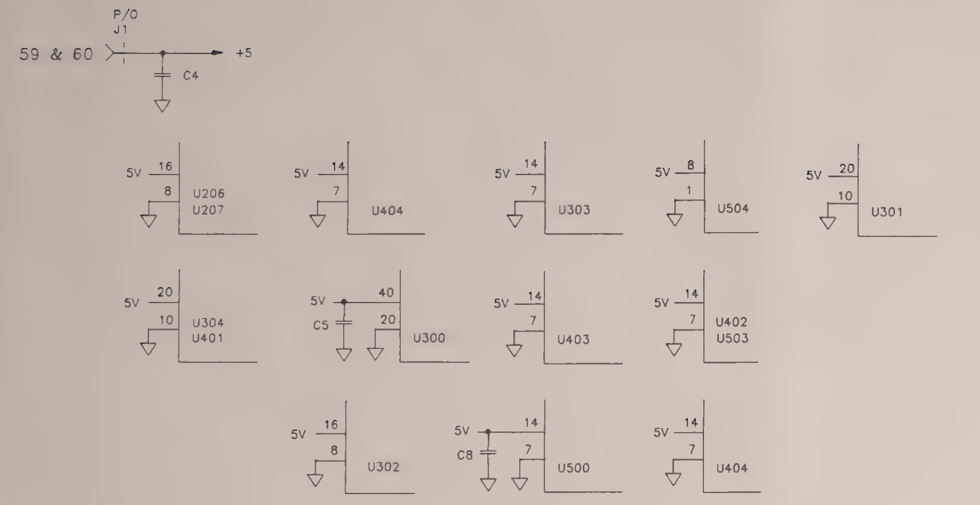


Figure 8-19. I/O Timer Schematic Block Diagram

Figure 8-20. A2 Memory Board Component Locator



Power and Grounds

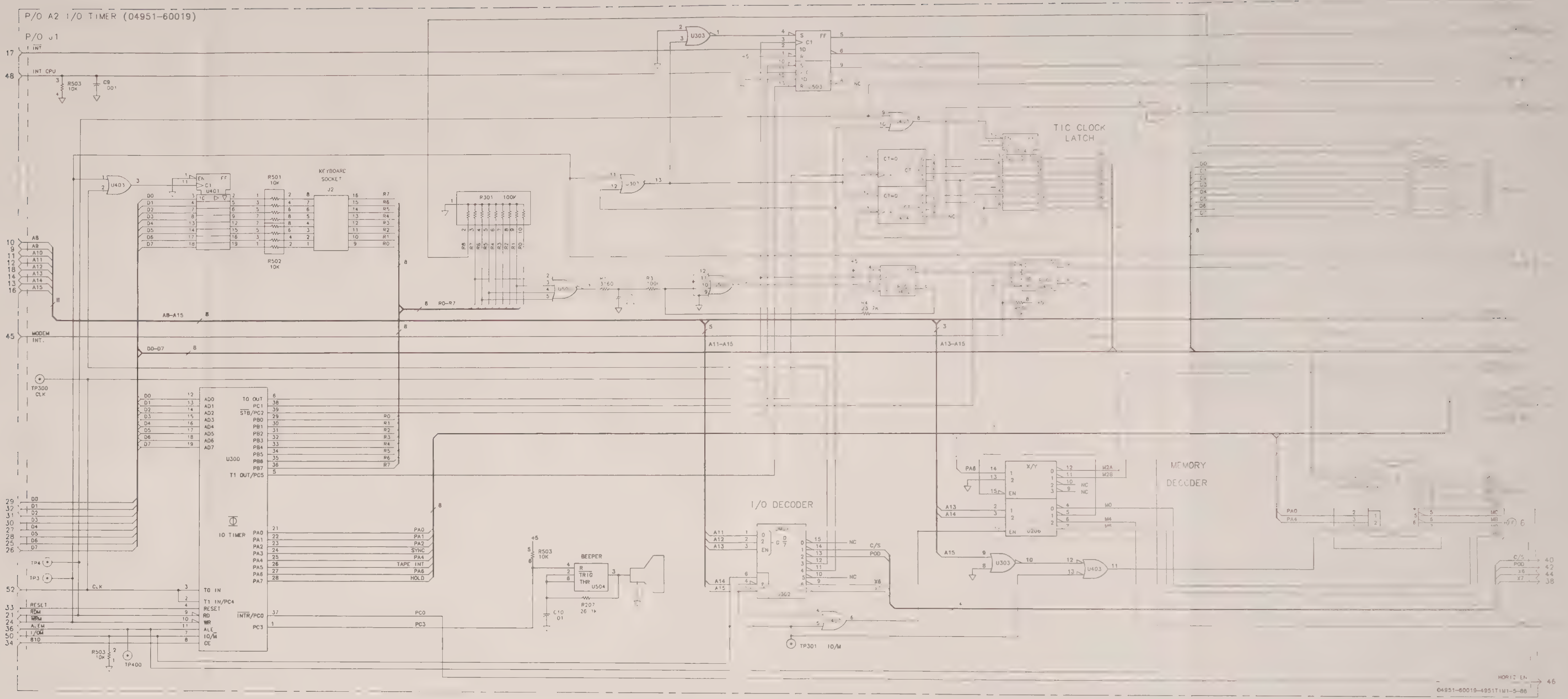


Figure 8-21. A2 I/O Timer Schematic

3

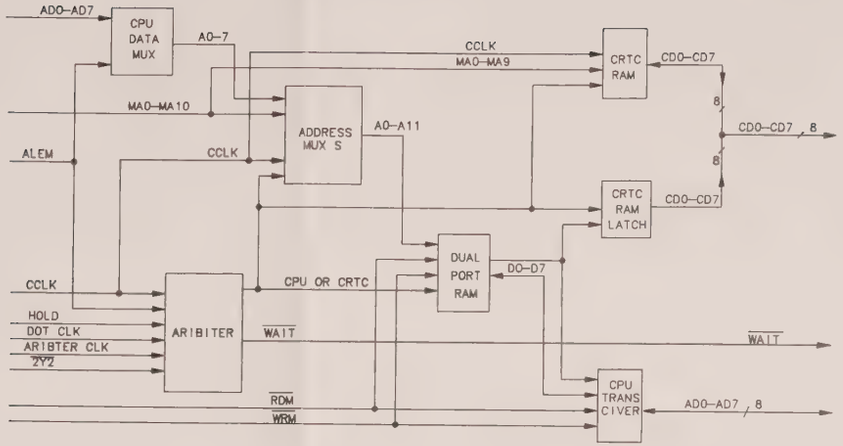
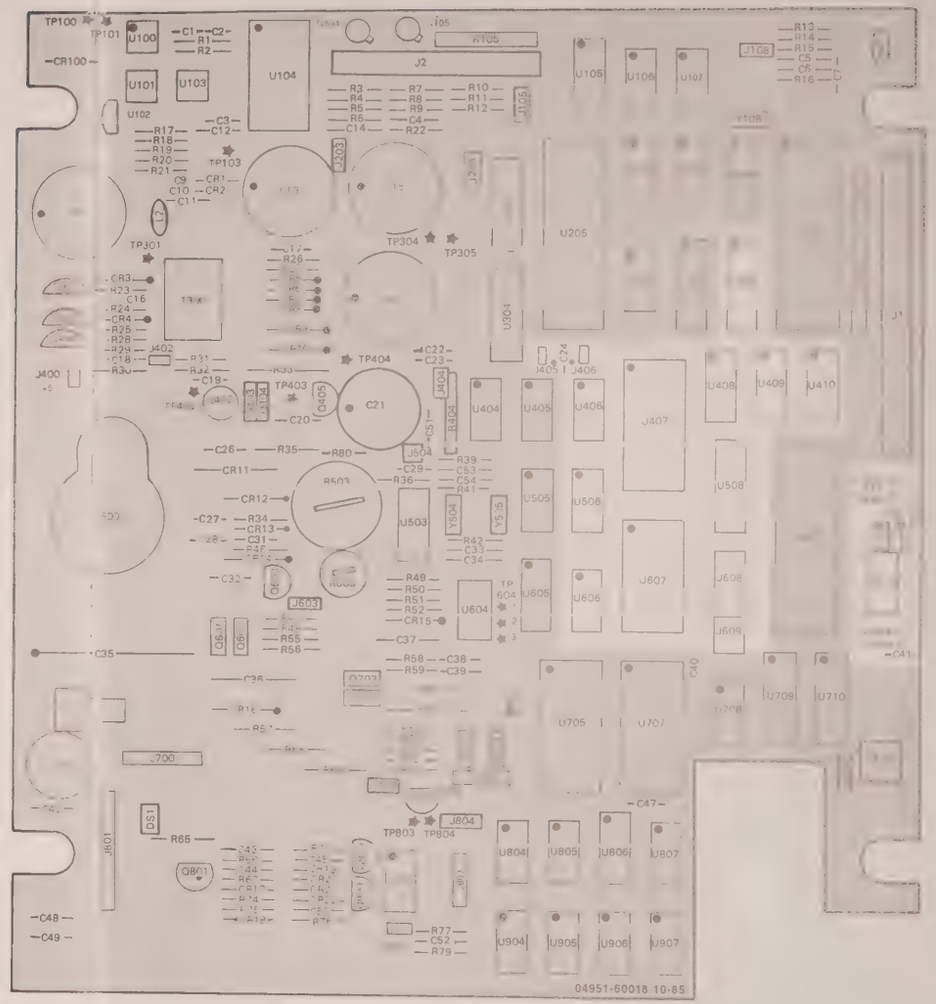
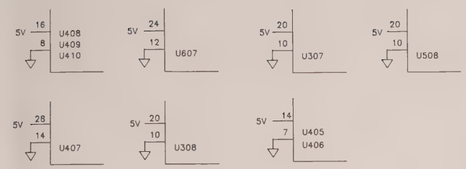


Figure 8-22. Dual Port RAM & Arbiter Schematic Block Diagram



A1 Main Board Component Locator



Power and Grounds

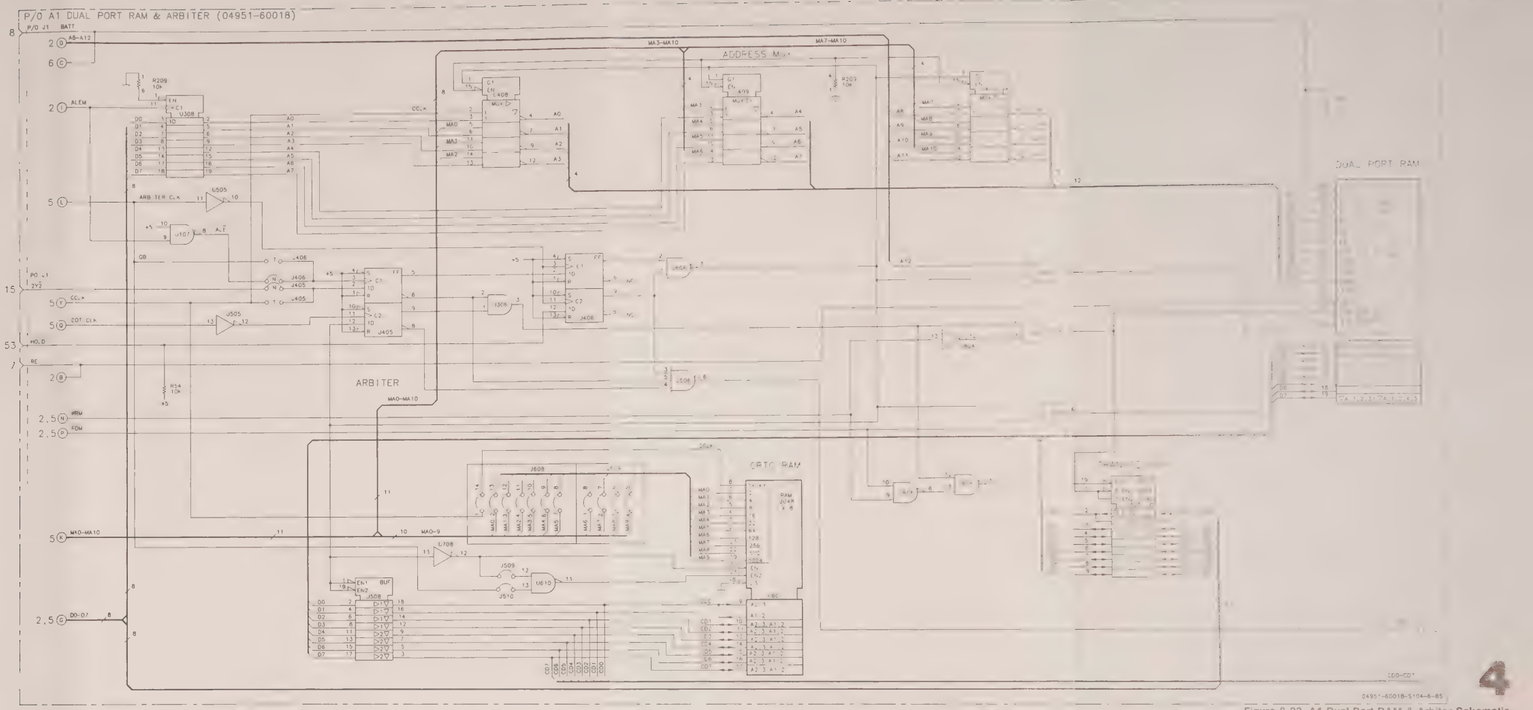


Figure 8-23. A1 Dual Port RAM & Arbiter Schematic

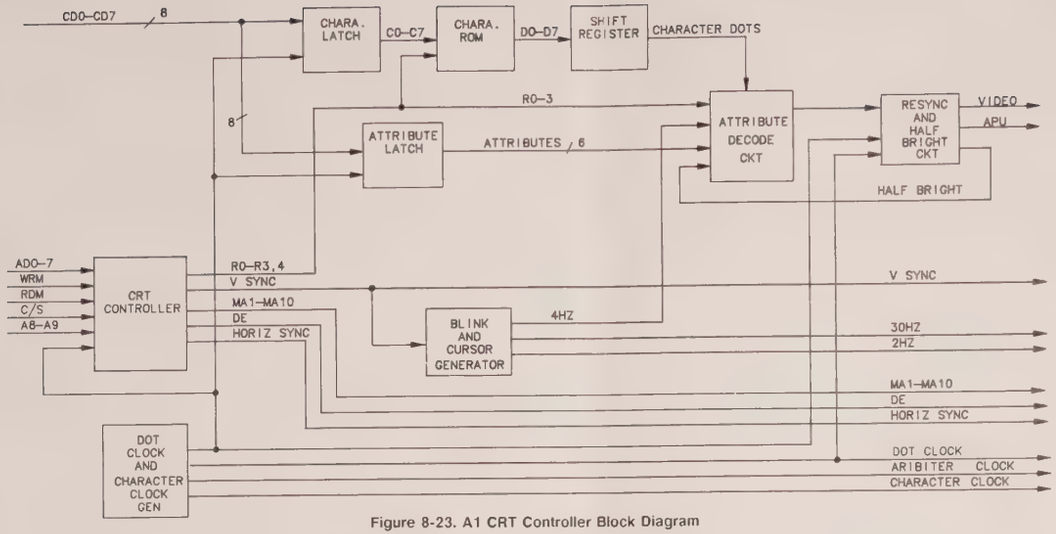
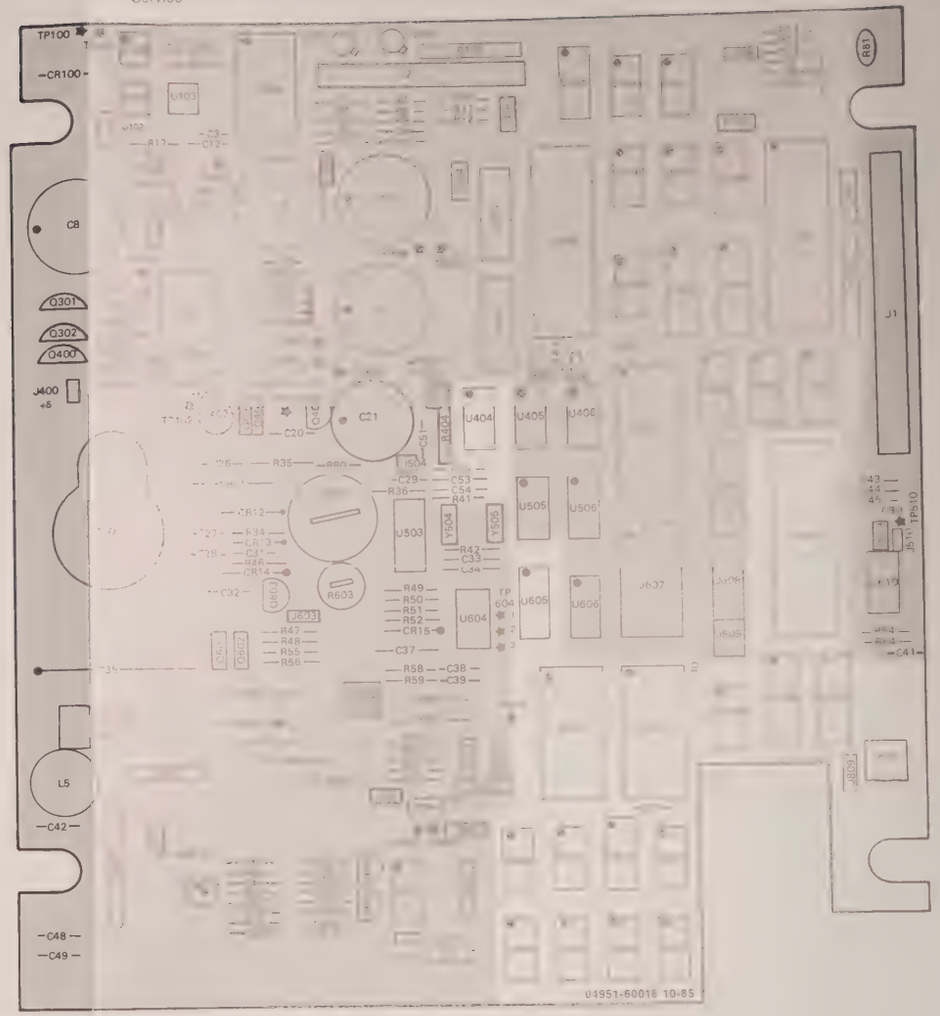
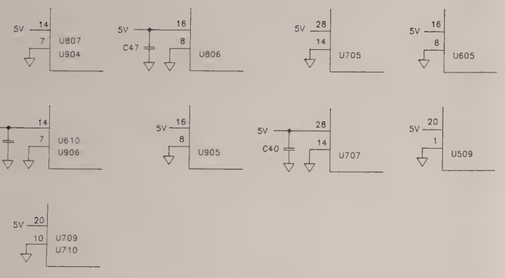


Figure 8-23. A1 CRT Controller Block Diagram

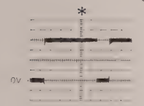


A1 Main Board Component Locator

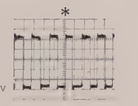


Power and Grounds

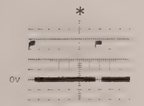
CRTC CONTROLLER



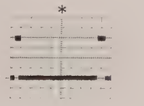
U509 pin 18, Display Enable
10 μsec/Div
1 V/Div, DC coupled



U509 pin 21, Character Clock
1 μsec/Div
1 V/Div, DC coupled



U509 pin 39, H Sync
10 μsec/Div
1 V/Div, DC coupled



U509 pin 40, VSYNC
2 msec/Div
1 V/Div, DC coupled

P/O Figure 8-26. A1 CRT Controller Schematic, Waveforms

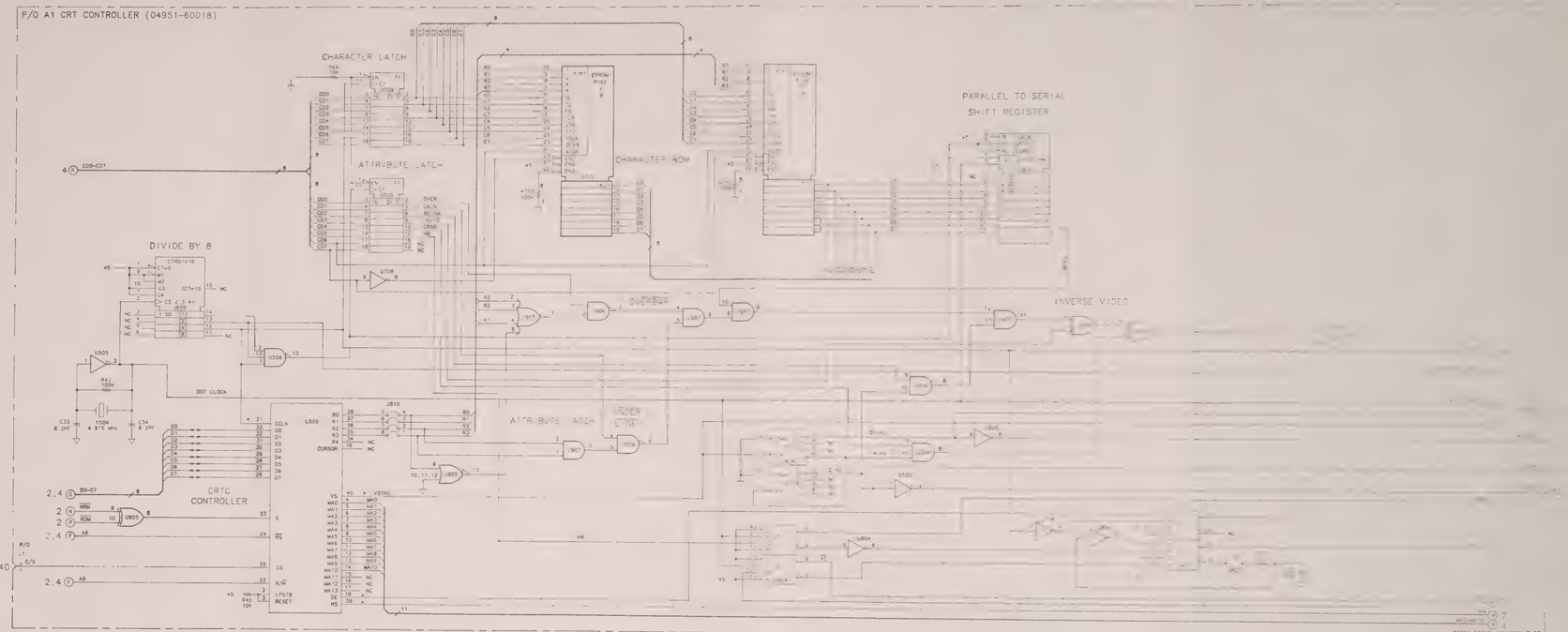
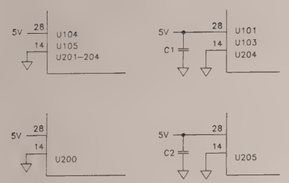


Figure 8-26. A1 CRT Controller Schematic

A2 Memory Board Component Locator



Power and Grounds

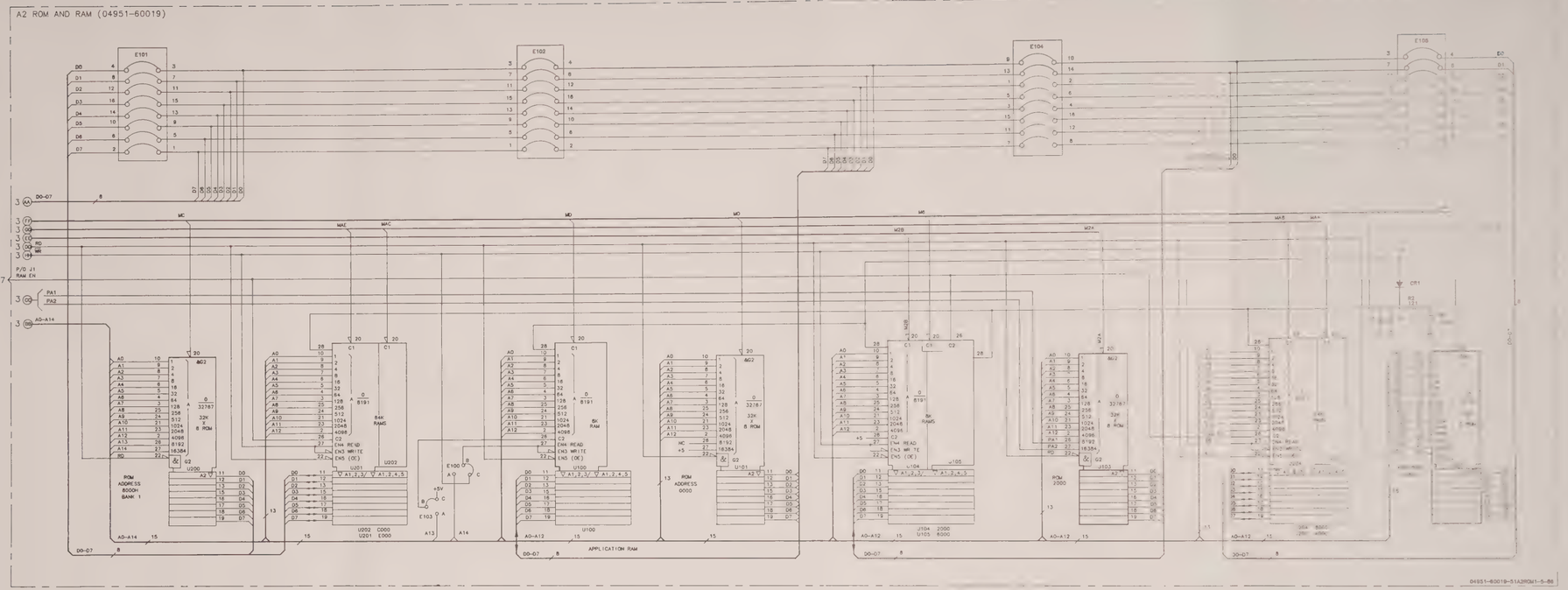


Figure 8-27. A2 ROM and RAM Schematic

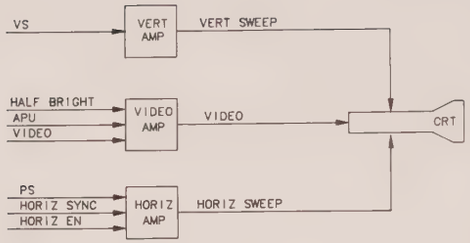
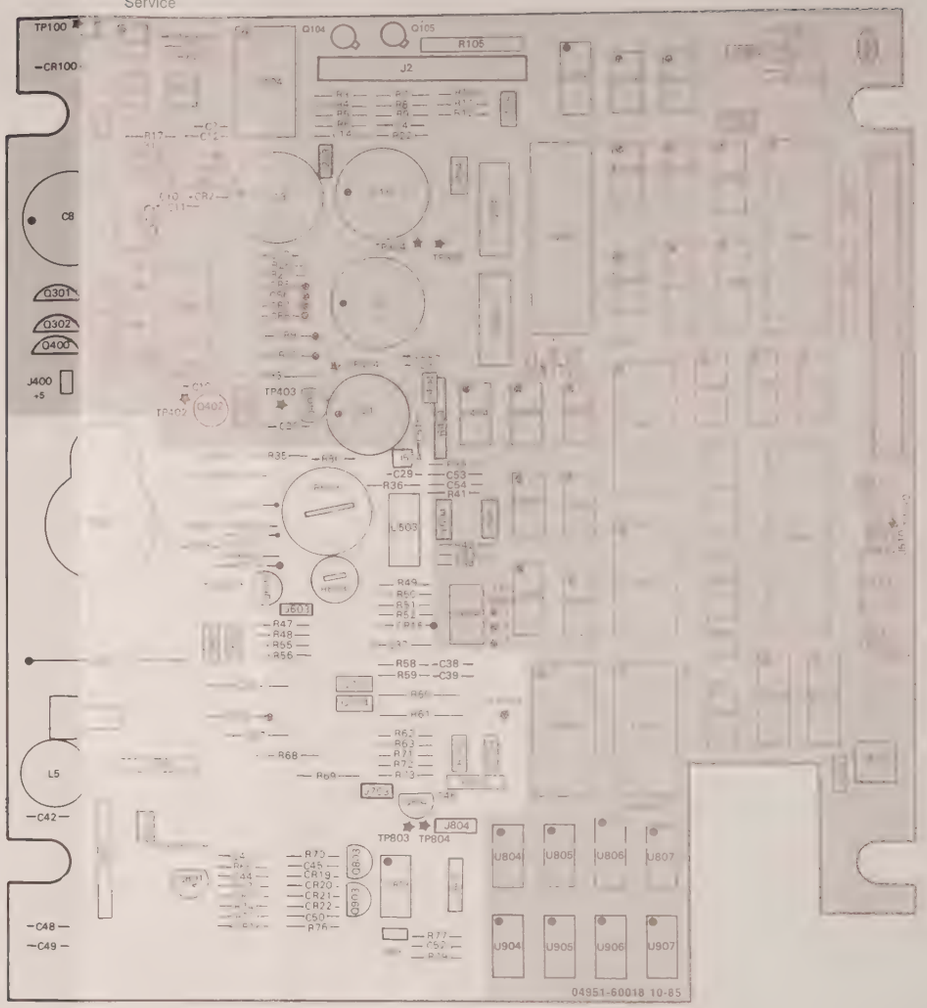


Figure 8-28. Deflection Schematic Block Diagram



A1 Main Board Component Locator

VIDEO AMPLIFIER

#1

Q803 base: Wake Up Conditions
5 msec/Div
5 V/Div, DC coupled

#2

Q803 collector: Wake Up Conditions
2 msec/Div
10 V/Div, DC coupled

#3

Q903 base: Wake Up Conditions
5 msec/Div
2 V/cm, DC coupled

#4

Q903 collector: Wake Up Conditions
5 msec/Div
5 V/Div, DC coupled

#5

TP803: Wake Up Conditions
5 msec/Div
5 V/Div, DC coupled

#6

Wake Up Conditions
J804 pin 12 of U803:
5 msec/Div
2 V/Div, DC coupled

HORIZONTAL AMPLIFIER

#7

U506 pin 8: Wake Up Conditions
10 μsec/Div
1 V/Div, DC coupled

#8

J603: Wake Up Conditions
20 μsec/Div
2 V/Div, DC coupled

#9

Wake Up Conditions
Q601-Q602 (drain) pin 3 (T300):
20 μsec/Div
20 V/Div, DC coupled

VERTICAL AMPLIFIER

#10

TP604 pin 3
5 msec/cm
1 V/cm, DC coupled

#11

TP604 pin 2
5 msec/Div
.5 V/cm, DC coupled

#12

TP704
5 msec/Div
5 V/Div, DC coupled

#13

TP604 pin 1
5 msec/cm
1 V/cm, DC coupled

Power and Grounds

5V 16 8 U503

5V 14 7 U506

5V 14 7 U803

12V 4
-12V 11 U604
C38
C39

P/O A1 DEFLECTION CIRCUIT (04951-60018)

HEIGHT & CENTER

VERTICAL HEIGHT ADJ

V DRV

VERT. CENTERING ADJ

VIDEO AMPLIFIER

H DRV

HORIZONTAL AMPLIFIER

INT. ADJ

FOCUS

HORIZ. WIDTH ADJ

H.V. VOLTAGE

INTERNAL CONNECTION

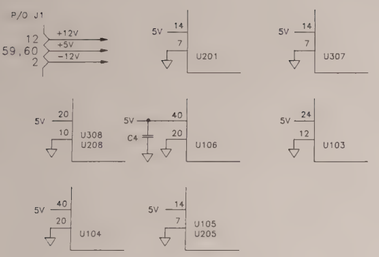
REG BLUE

P/O Figure 8-30. A1 Deflection Circuit Schematic, Waveforms

04951-60018-4510C52-5-84

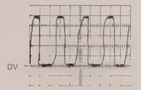
7

Figure 8-30. A1 Deflection Circuit Schematic



Power and Grounds

I/O SYSTEM CLOCK



A3U106 pin 1
2 μsec./ Div
1 V./Div, DC coupled

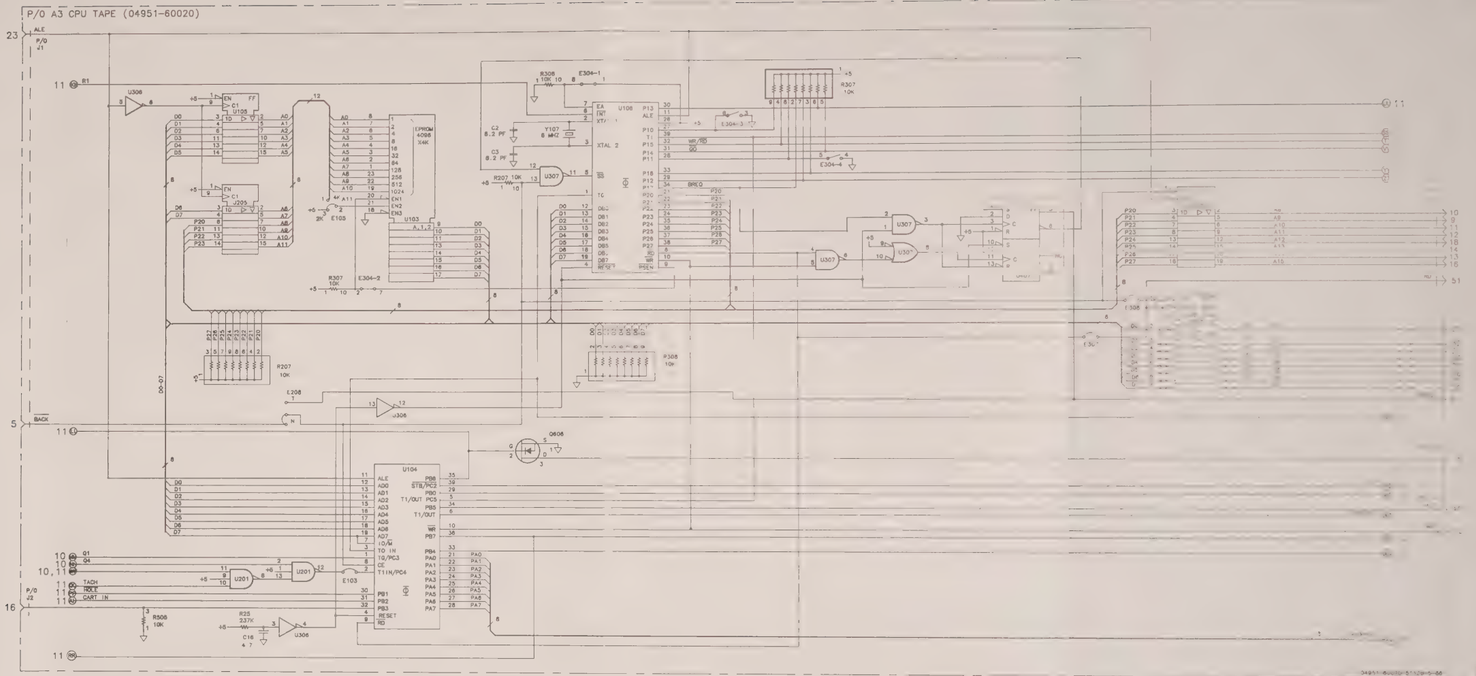
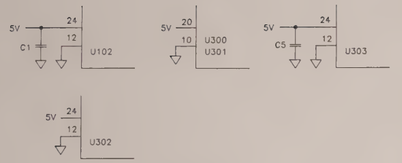


Figure 8-33. A3 Tape Board CPU Schematic

A3 Tape Board Component Locator



Power and Grounds

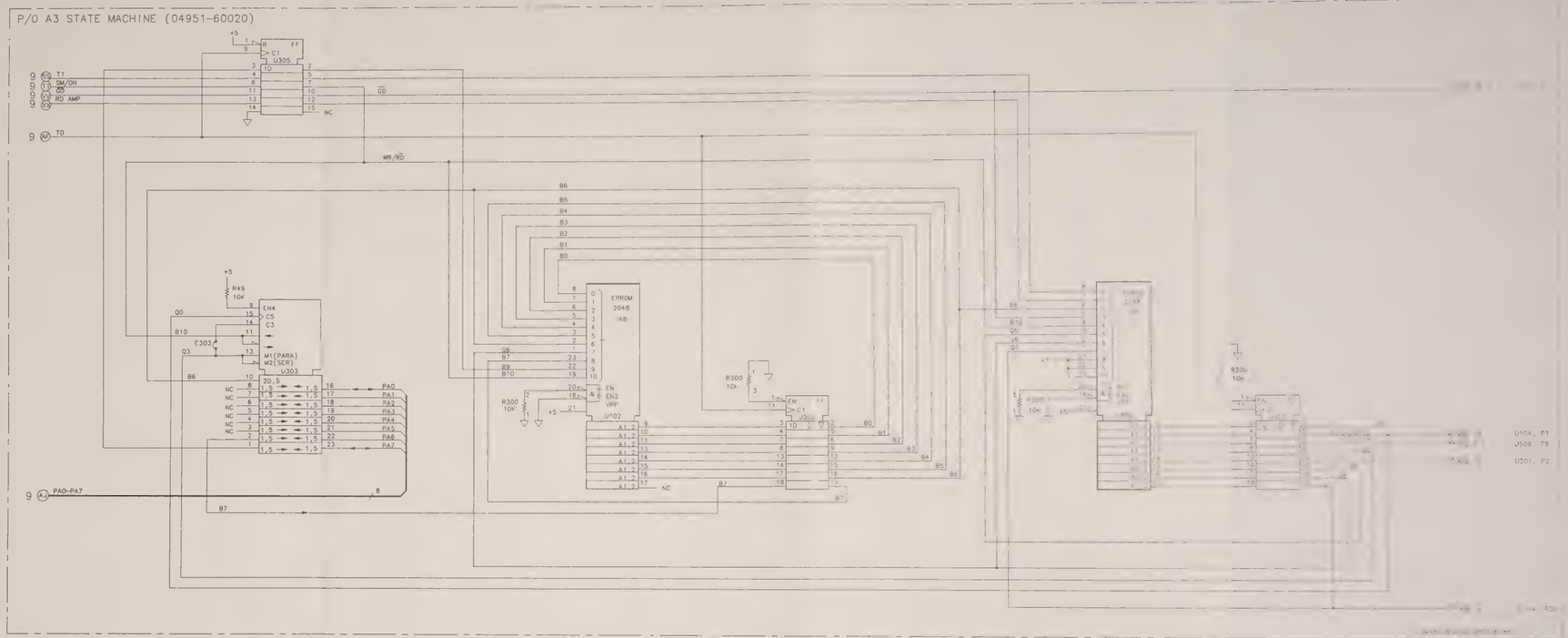
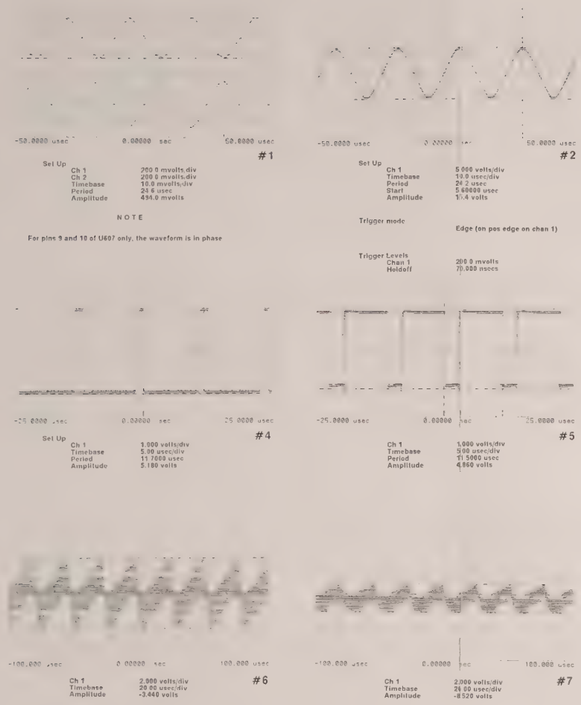
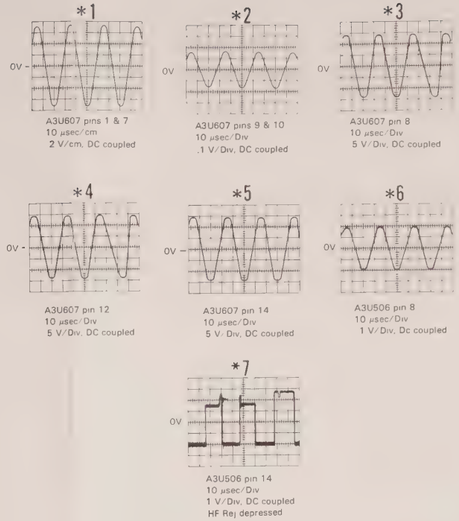


Figure 8-34. A3 State Machine Schematic



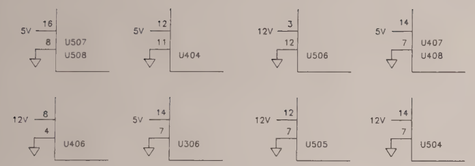
P/O Figure 8-36. A3 Real/Servo Loop Schematic, Waveforms



SEE WAVEFORM * OR # FOR WAVEFORM.

P/O Figure 8-36. A3 Read Amplifier & Speed Control Schematic, Waveforms

A3 Tape Board Component Locator



Power and Grounds

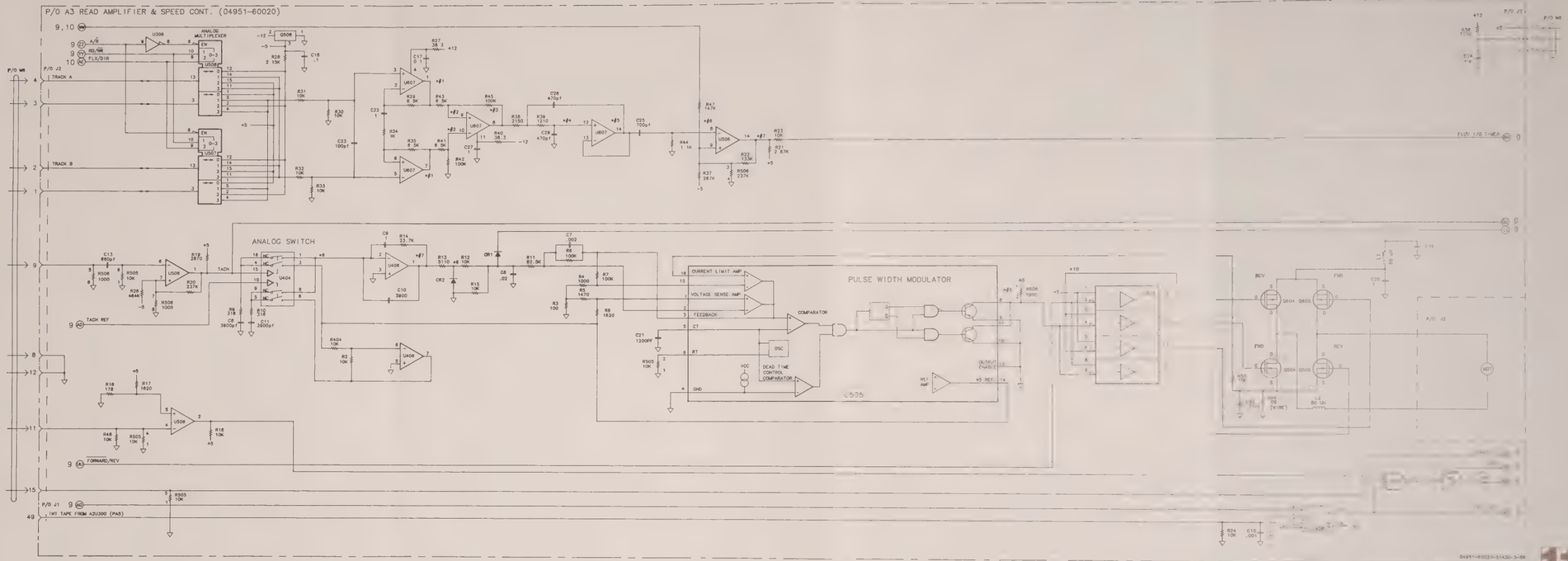


Figure 8-36. A3 Read Amplifier and Speed Control Schematic

Figure 8-37. A4 Printer/Video Component Locator

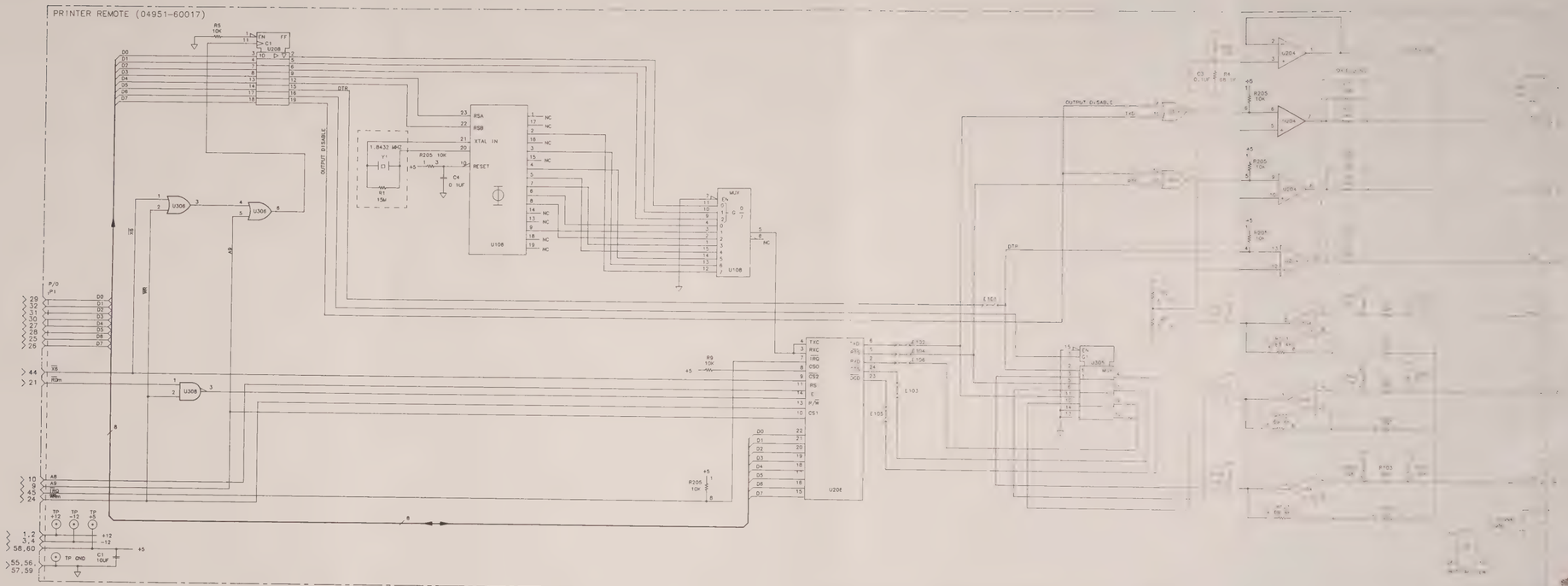
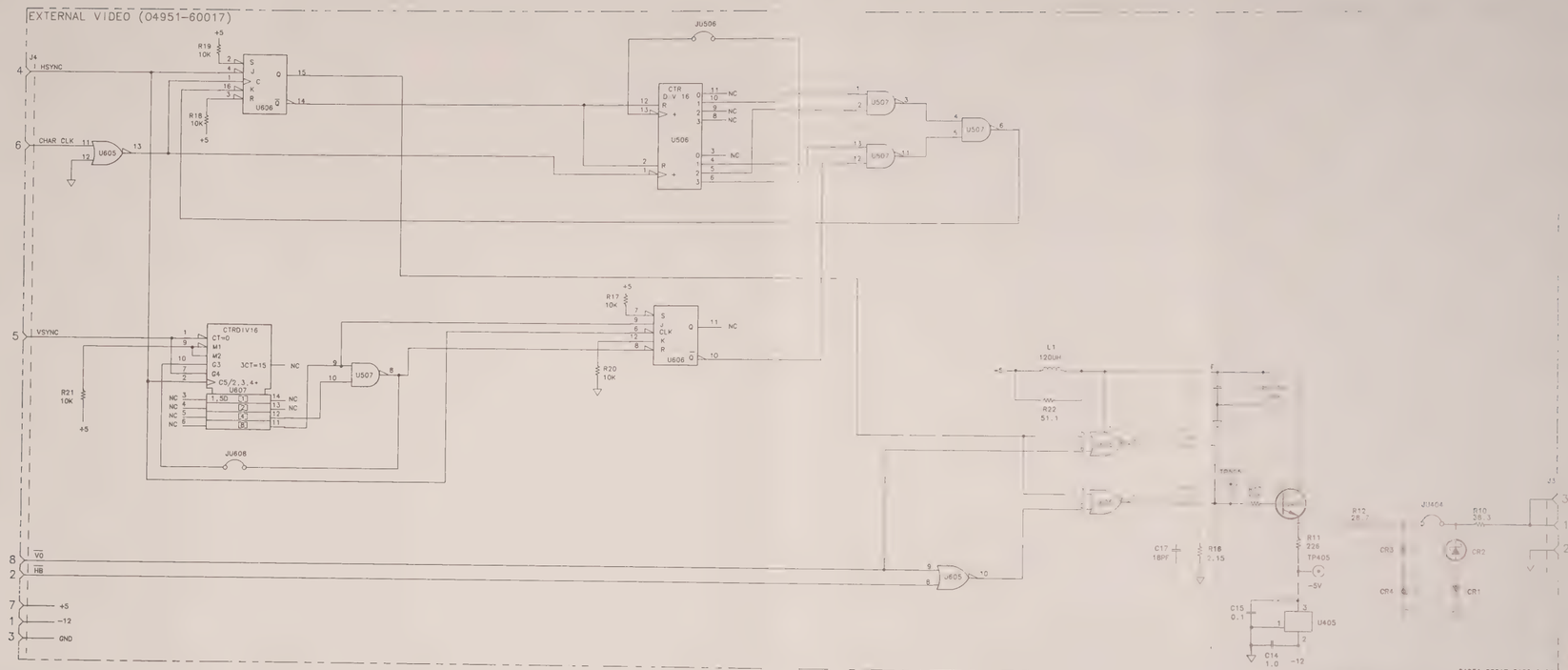


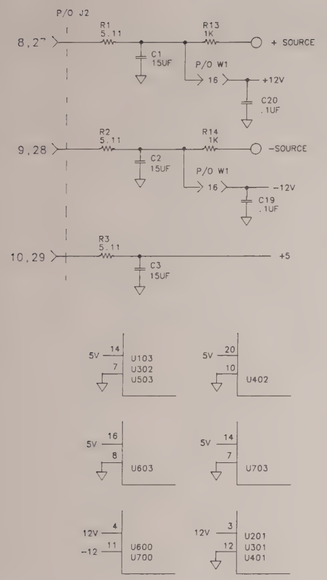
Figure 8-38. A4 Printer Remote Schematic

A4 Printer/Video Component Locator



13

Figure 8-39. A4 External Video Schematic



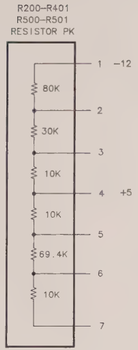
HP 18173A Power and Grounds

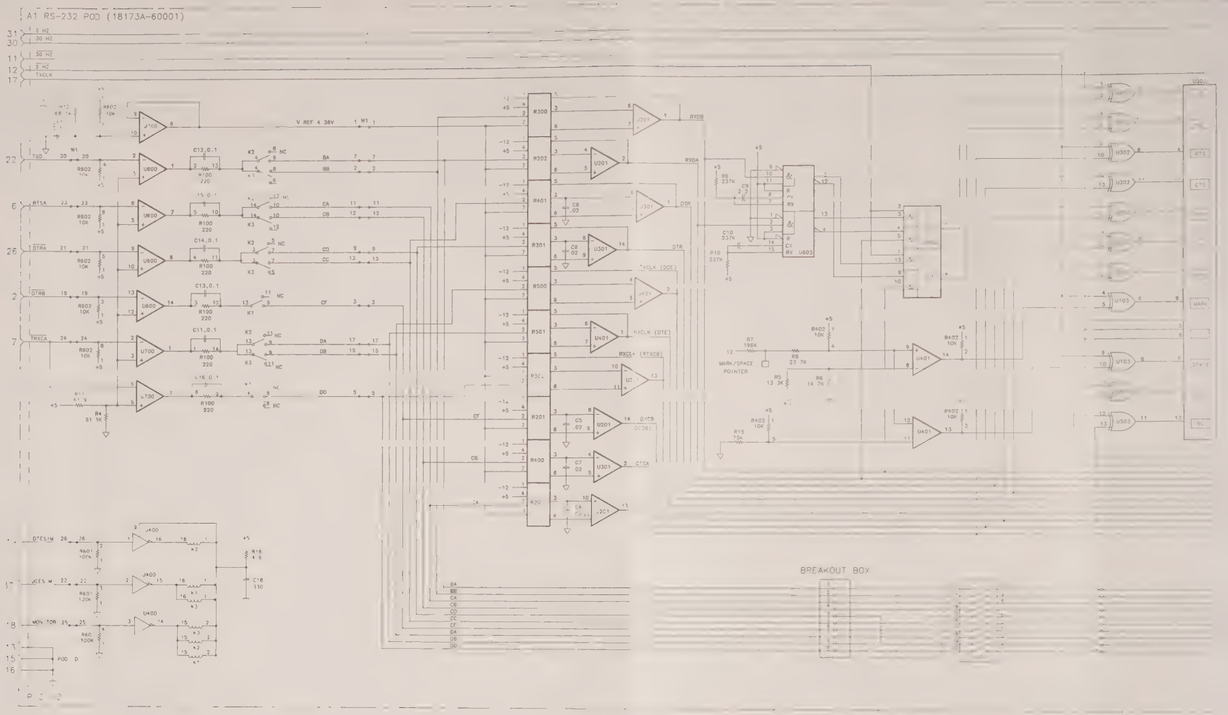
TOP OF BD.
K1

	1	2	4	6	8			
16	15	13	11	9				

BOTTOM VIEW
K2 & K3

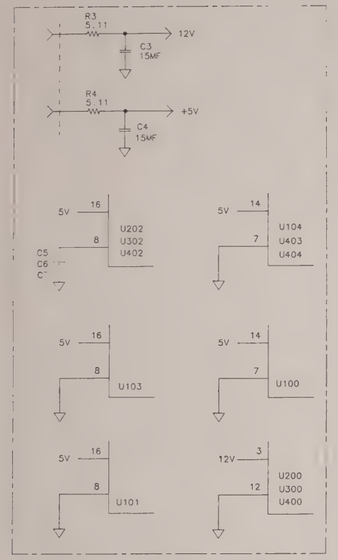
7	5	3	1	2	4	6	8	
10	12	14	16	15	13	11	9	



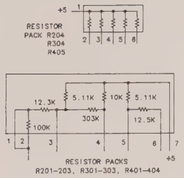


18173-60001-5106-7-85

Figure B-5. HP 18173A Interface Pod Schematic



Power and Grounds



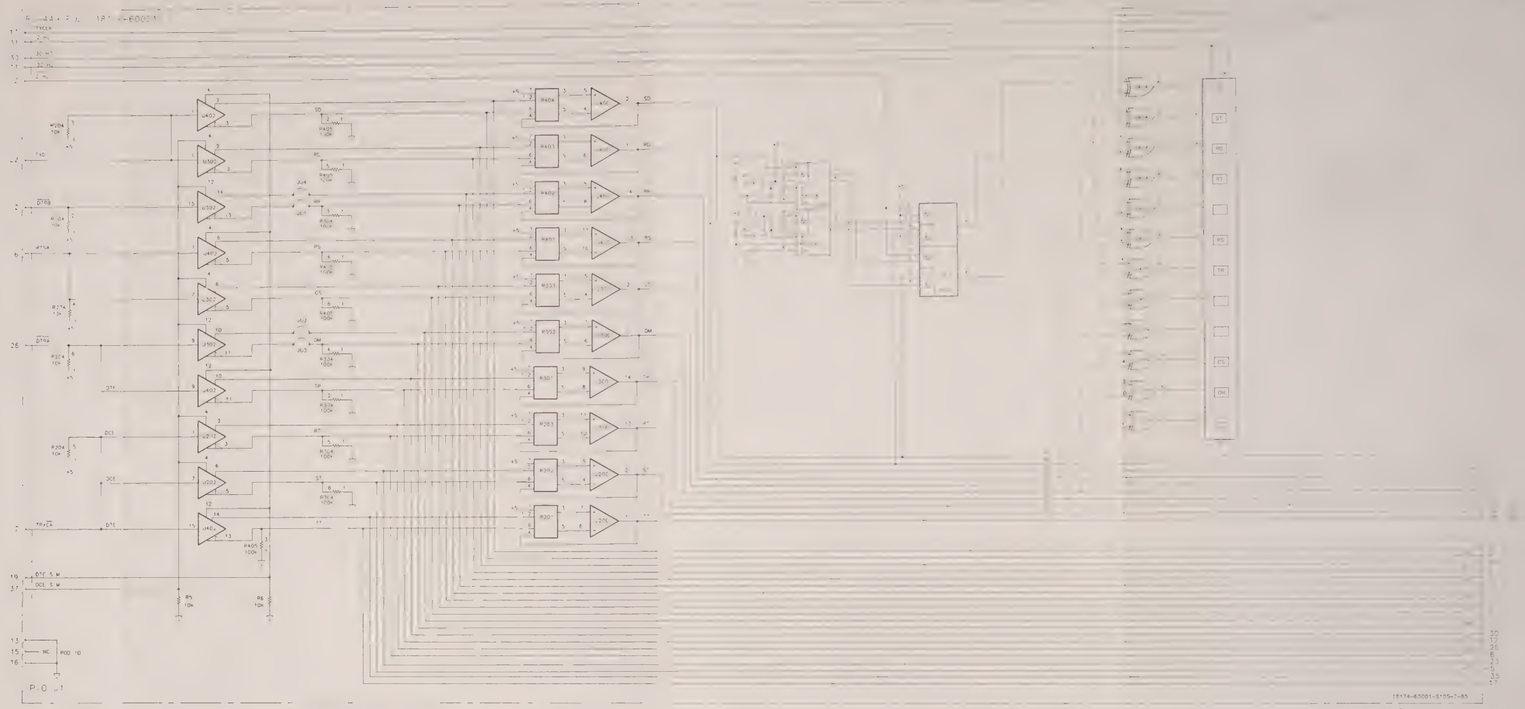


Figure C-5. HP 18174A Interface Pod Schematic

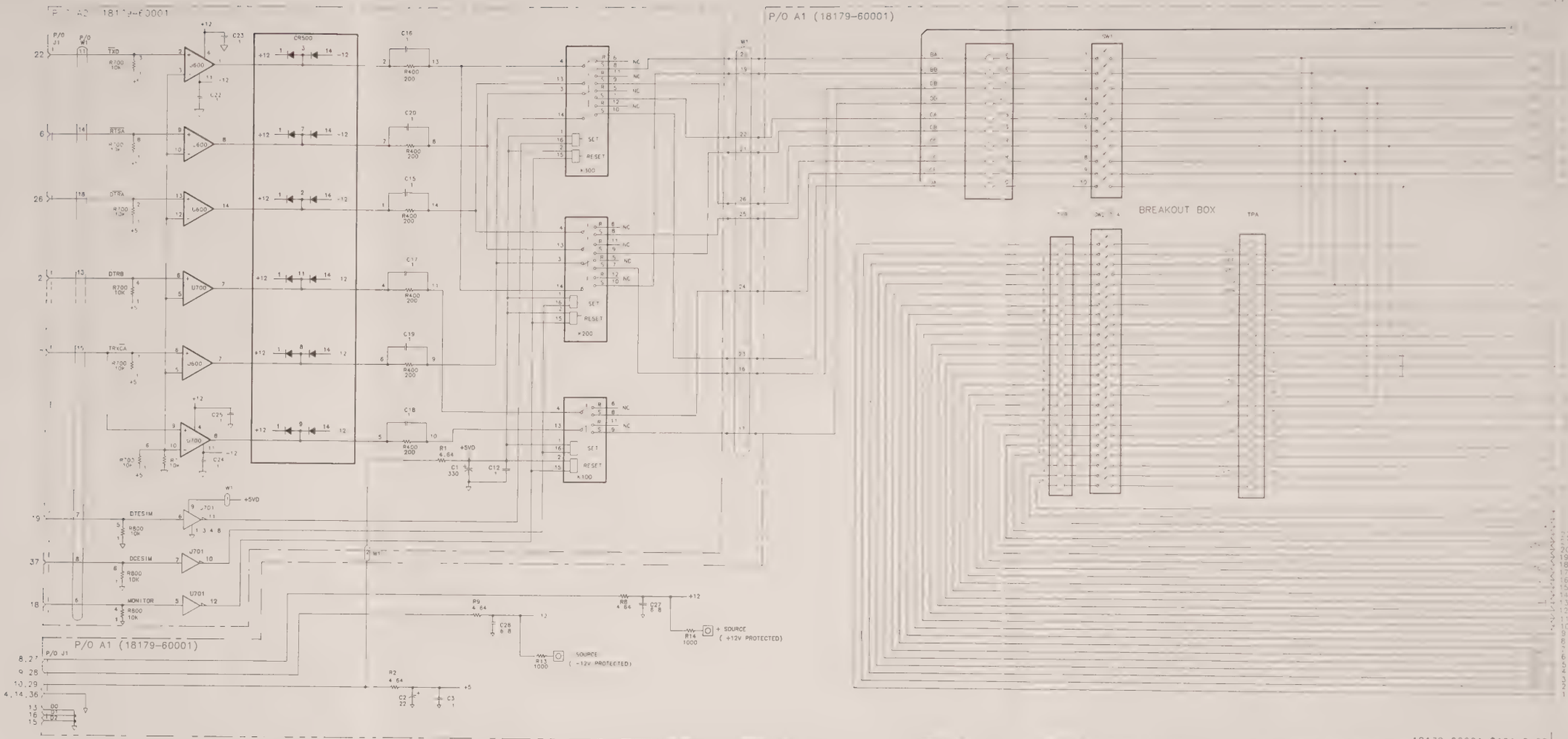
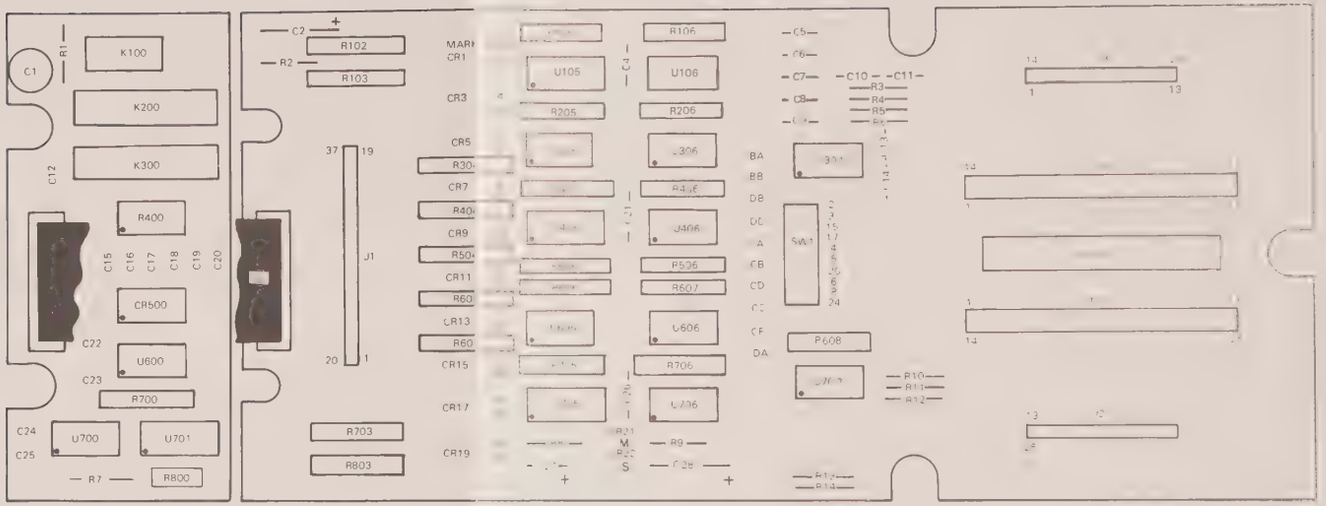


Figure E-6. HP 18179A Control Schematic



HP 18179A Component Locator

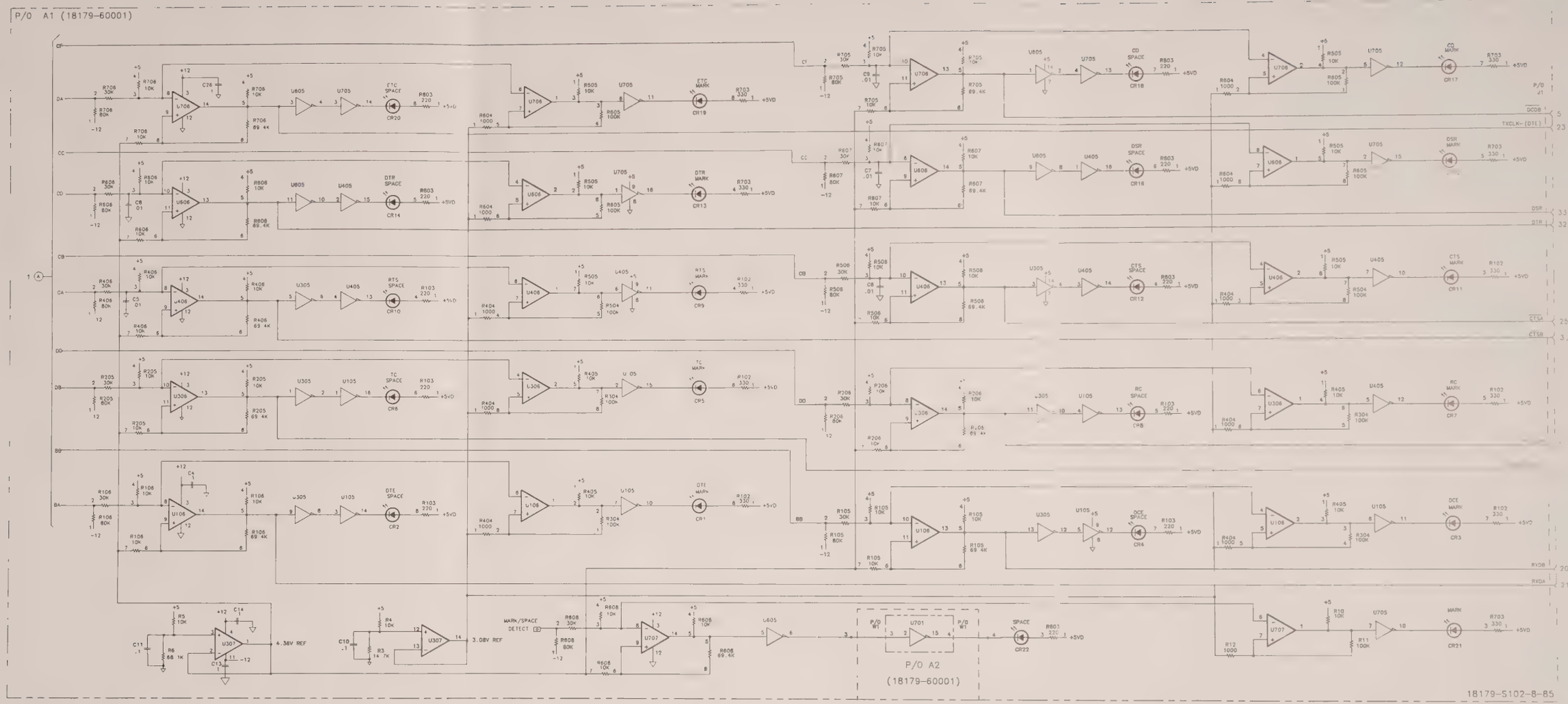


Figure E-7. HP 18179A Transmitter/Receiver Schematic

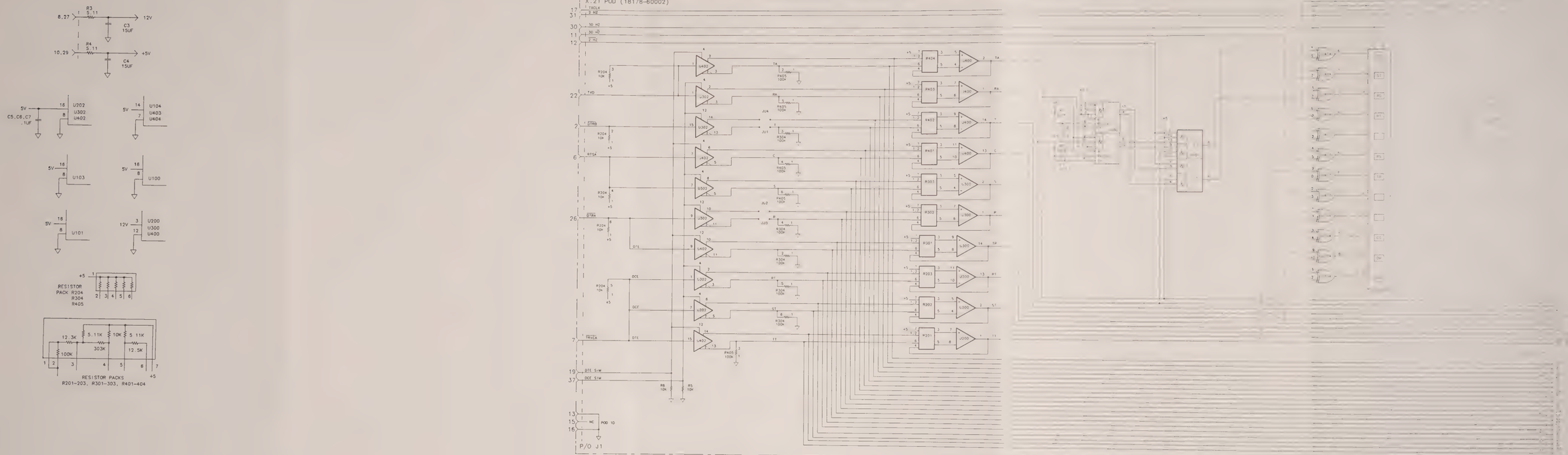
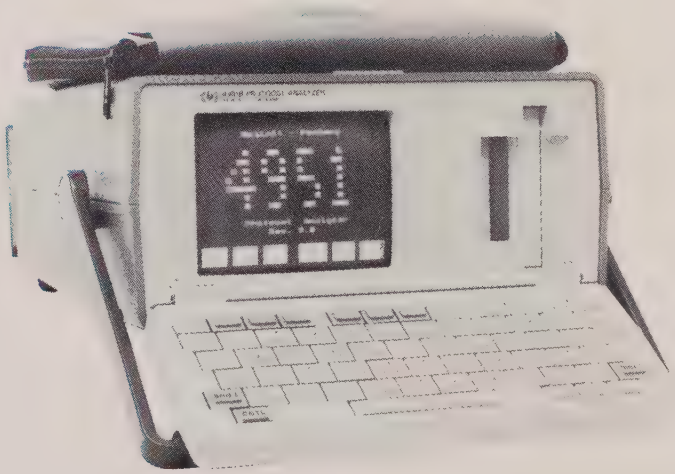


Figure F-4. HP 18178A Interface Pod Schematic

SERVICE MANUAL

4951B PROTOCOL ANALYZER AND ACCESSORIES



HEWLETT PACKARD

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this product.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, HP will, at its options, either repair or replace products which prove to be defective.

For Warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designed by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance. No other warranty is expressed or implied. HP specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

EXCLUSIVE REMEDIES

The remedies provided herein are buyer's sole and exclusive remedies. HP shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

HEWLETT
PACKARD

Service Manual

HP 4951B
PROTOCOL ANALYZER

SERIAL NUMBERS

This manual applies to instruments with serial numbers prefixed 2612A.

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5070 CENTENNIAL BLVD., P.O. BOX 7050, COLORADO SPRINGS, COLORADO 80933

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Manual Part No: 04951-90040
Microfiche Part No: 04951-90021

Printed: June 1986
Printed in USA

WARNING

SAFETY

If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THIS INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

GROUNDING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

HIGH VOLTAGE

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Adjustments and service described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points, if contacted, result in personal injury.

CAUTION

LINE VOLTAGE

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument requirements match the voltage of the power source.

GROUNDING

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground.

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

IEC SYMBOLS

The following is a list of key IEC symbols used by Hewlett-Packard. All symbols are normally applied adjacent to the device requiring the symbol. They shall not be placed on removable parts likely to be detached or lost.

Instruction Manual symbol: If necessary, to preserve the apparatus from damage it is necessary for the user to refer to the instruction manual, then shall the apparatus be marked with this symbol (IEC 348;16a).

Terminal devices fed from the interior by live voltages that may be dangerous when connecting to or disconnecting from those devices shall be marked with the flash shown when the voltage exceeds 1 KV: The flash shall be red (IEC 348;18c).

Earth Terminals. If the use of this symbol for the protective earth terminal is not permitted by National Standards, it may be modified, for example, by being placed inside a circle (IEC 348;18a).

AC current (IEC 117-1, symbol No. 3).

DC current (IEC 117-1, symbol No. 2).

AC or DC current (IEC 117-1, symbol No. 8).

Frame or chassis connection. The hatching may be completely or partly omitted if there is no ambiguity. If the hatching is omitted, the line representing the frame or chassis shall be thicker (IEC 117-1, symbol No. 87).

A — Ampere (IEC 117-4, symbol No. 356).

V — Volt (IEC 117-4, symbol No. 357).

VA — Voltampere (IEC 117-4, symbol No. 358).

W — Watt (IEC 117-4, symbol No. 360).

Wh — Watthour (IEC 117-4, symbol No. 361).

VAh — Voltamperehour (IEC 117-4, symbol No. 362).

Hz — Hertz (IEC 117-4, symbol No. 365).

Contactor, normally closed. In order to avoid confusion with the symbol for a capacitor, the distance between the horizontal (as drawn here) lines should be at least equal to the length of those lines (IEC 117-3, symbol No. 215.2).

In addition the following describes the use of Warnings, Cautions and Notes used in HP Automatic Test System Manuals.

Warnings, cautions and notes. (All) Warnings and cautions shall precede the text to which each applies but notes may precede or follow applicable text depending on the material to be highlighted. Warnings, cautions, and notes shall not contain procedural steps nor shall they be numbered. When a warning, caution, or note consists of two or more paragraphs, the heading WARNING, CAUTION, NOTE, shall not be repeated above each paragraph. If it is ever necessary to precede a paragraph by both a warning and a note, or a caution and a note, etc, they shall appear in the sequence as noted, namely, warnings, cautions, notes. Such inserts in the text shall be short and concise and be used to emphasize important and critical instructions.

WARNING

An operating procedure, practice, etc, which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc. which, if not strictly observed, could result in damage to, or destruction of, equipment.

NOTE: An operating procedure, condition, etc. which it is essential to highlight.

Health hazards precaution data. (All) When hazardous chemicals or adverse health factors, in the environment or use of the equipment cannot be eliminated, appropriate precautionary requirements shall be included.

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Figure 1-1. HP 4951

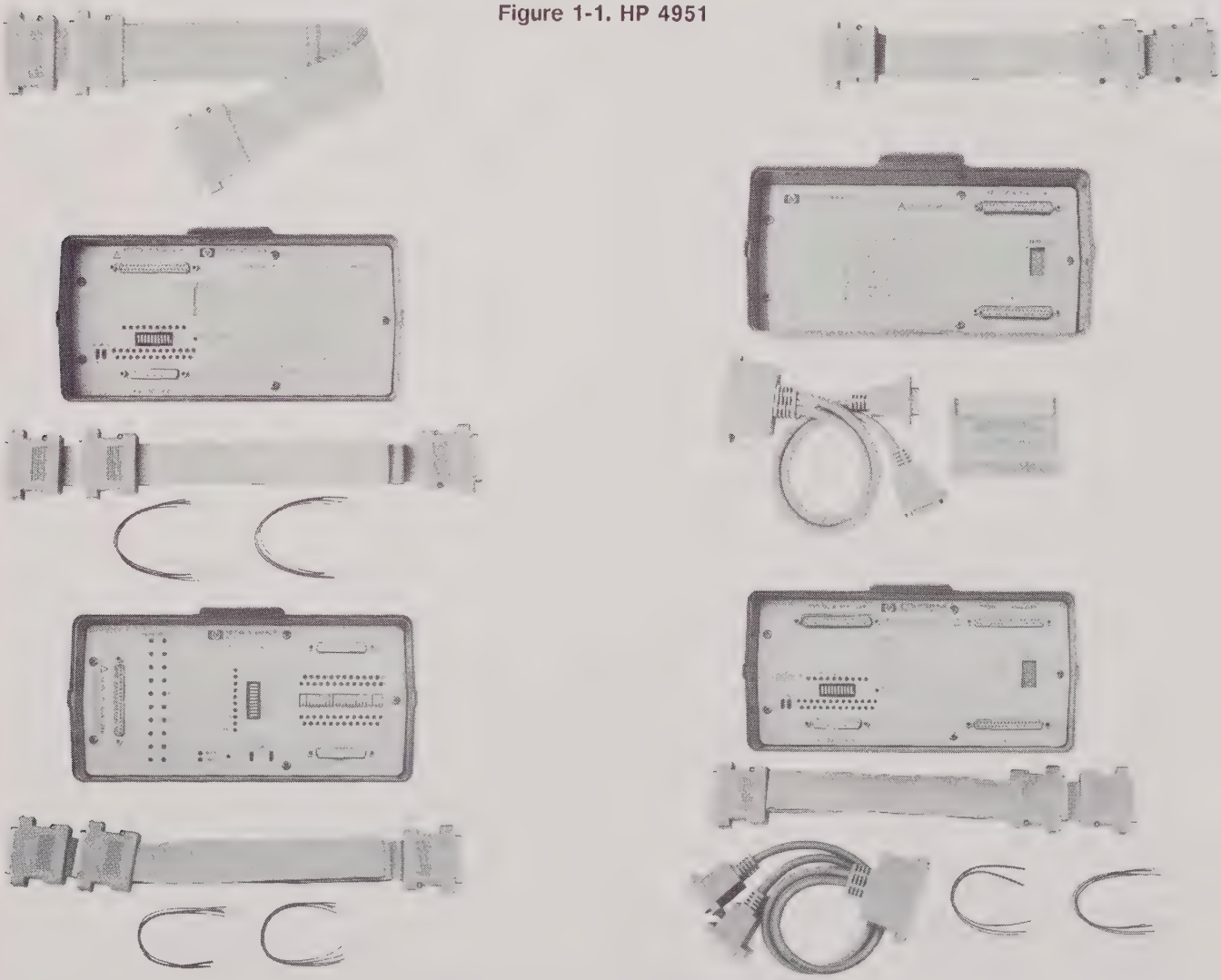


Figure 1-2. HP 4951 Accessories

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information for the HP 4951 Protocol Analyzer, the HP 18173A RS-232C/V.24 Interface Pod, the HP 18174A RS-449 Interface Pod, the HP 18180A RS-232C/V.24 Interface Pod, the HP 18179A Interface Pod, and the HP 18197A Interface Pod. Basic operating and detailed service information are included. Figure 1-1 shows the Protocol Analyzer and Figure 1-2 shows the available accessories. The manual is divided into eight main sections. The Interface Pods are described in the appendices.

Section I, General Information contains specifications and a brief description of the HP 4951 Protocol Analyzer. General information for each of the Interface Pod accessories is contained in the appropriate appendix.

Section II, Installation gives instructions for setting up the Protocol Analyzer. Installation information for each of the Interface Pod accessories is contained in the appropriate appendix.

Section III, Operation describes basic operating procedures. Operating information for each of the Interface Pod accessories is contained in the appropriate appendix.

Section IV, Performance Verification details the test procedures that verify instrument performance. The complete Performance Verification procedure is contained in this section with the applicable tests for each Interface Pod repeated in the appropriate appendix.

Section V, Adjustments gives procedures for making all adjustments to the Protocol Analyzer. There are no adjustments to make on the Interface Pods.

Section VI, Replaceable Parts provides information required to order all parts and assemblies for the HP 4951. Replaceable parts for the accessories are contained in the appropriate appendixes.

Section VII, Manual Changes contains information to backdate the manual for instruments with serial numbers earlier than listed on the Title Page. Also contains backdating information for the HP 4951A.

Section VIII, Service provides service and troubleshooting information. This includes Theory of Operation, Block Diagrams, Troubleshooting Procedures, Component Locators, and Schematics. The service information for each accessory is located in the appropriate appendix.

Appendix A, Guide to Interpreting ANSI provides a basic description of ANSI symbology.

Appendix B, HP 18173A RS-232C/V.24 Interface Pod contains a description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic.

Appendix C, HP 18174A RS-449 Interface Pod contains a description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic.

Appendix D, HP 18180A RS-232C/V.24/RS-449 Interface Pod contains a description of the instrument.

Appendix E, HP 18179A RS-232C/V.24 Interface Pod contains a description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic.

Appendix F, HP 18178A X.21 Interface Pod contains a description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic.

Appendix G, HP 18197A RS-232C/V.24/X.21 Interface Pod contains a description of the instrument.

HP 18177A V.35 Interface Pod contains a description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic. Available as supplement to manual.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. Table 1-1 provides the performance standards or limits of this instrument. Instrument characteristics are described in Table 1-2.

Table 1-1. HP 4951 Instrument Specifications

Weight:	Net, 6.4 kg (14.2 lb) Shipping, 10.4 kg (23 lb)
Size:	Height 11.2 cm (4.4 in) Width 25.9 cm (10.2 in) Depth 28.6 cm (11.3 in)
Temperature:	Operating 0^{o}C to $+55^{o}$C (32^{o}F to 131^{o}F)* Storage -40^{o}C to $+75^{o}$C (-40^{o}F to $+167^{o}$F) *Tape drive should only be operated from $+5^{o}$C to $+40^{o}$C ($+41^{o}$F to $+104^{o}$F)
Altitude:	Operating - 4600 m (15000 ft) Storage - 15300 m (50000 ft)
Power Requirements:	100, 120, 220, 240 VAC, -5% to +10%; 48-66 Hz single phase; Typical less than 15 VA, maximum less than 30 VA

Table 1-2. HP 4951 Operating Characteristics

* **Full ASCII keyboard.**
* **Auto-Configure.** Automatically determines a line's protocol, data code, speed, parity, and error checking.
* **Softkey guided measurements.** Simplifies setup and programming.
* **63 triggers.** Trigger on errors, lead transitors or characters real-time or in a post analysis mode.
* **5 timers and 5 counters.** Count events and measure time intervals between triggers.
* **Non-volatile memory.** 32 Kbytes for automatically storing data. Non-volatile memory retains setups, monitors, and simulates programs.
* **Remote.** Transfer data, setups, monitor and simulate menus between two HP 4951s or between your HP 4951 and another HP Protocol Analyzer.
* **BERT.** Measure bit errors, block errors, and percent error free seconds.
* **Tape Storage, Option 001.** Mass storage of data, setups, programs, and measurements. Has 32 kbytes of non-volatile memory.
* **Katakana, Option 003.** (JIS-7, JIS-8, EBCDIC) Data Codes.

1-3. SAFETY CONSIDERATIONS

When internal circuits are exposed, caution must be used. Observe all warnings and cautions marked on the instrument or listed in the procedures.

WARNING

8000 volts may be present in the HP 4951 circuitry even when turned off.

CAUTION

The internal circuits of this instrument are static sensitive.
Refer to paragraph 8-6 for handling procedures.

This is a Safety Class 1 product which must be connected to a protected earth ground.

1-4. SAFETY SYMBOLS

A complete list of safety symbols used in this manual is given on the page preceding the Table of Contents.

1-5. INSTRUMENT IDENTIFICATION

The HP 4951 is manufactured in two locations, one in Europe and one in the United States. When ordering parts or service it is important to correctly identify the manufacturing location so that Hewlett-Packard may give you the best possible service. The manufacturing location is apart of the serial number, the serial number tag is on the back panel of your HP 4951 and is similar to the picture in Figure 1-3.

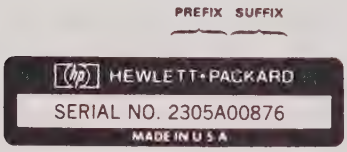


Figure 1-3. Serial Number Tag

The serial number has two parts. The first four digits and the letter are the serial number prefix. The last five digits form a sequential suffix, unique to each instrument. Look at the serial prefix; if it contains an A, then your instrument was manufactured in the United States, if it contains an F, then it was manufactured in Europe.

This manual applies to instruments with the same or a lower serial number prefix as that listed under SERIAL PREFIXES on the Title Page. An instrument manufactured after the printing of this manual may have a serial prefix higher than listed on the Title Page. This indicates that the protocol analyzer has been modified and a yellow Manual Change Sheet will accompany the manual to provide information to adapt the manual to the newer instrument.

1-6. HP 4951 DESCRIPTION

The HP 4951 is a complete field service data communications Protocol Analyzer. It is small, lightweight and easy-to-use. It contains the essential features needed to verify proper data equipment installation and maintenance. It correctly diagnoses system operating problems and assists in their correction. The Protocol Analyzer can simulate network components, monitor data transmission, and perform bit error tests. Data analysis may be done real time or in the post-processing mode. The 32 kbytes of non-volatile memory stores all data, timing, and lead status information. Additional non-volatile memory keeps all test setups as well as monitor and simulate programs. For long term storage of data and important test programs, the optional mass storage cassette tape (Option 001) stores an additional 512 kbytes of information.

Six software defined keys (softkeys) provide operator interface to the extensive troubleshooting capability of the HP 4951. Whenever an instruction indicates use of a soft key, its mnemonic will be enclosed by < >. The user friendly interface, combined with auto-configuration of all data link parameters, allows many complex tasks to be performed quickly and easily, resulting in less network downtime. The HP 4951 has 63 real time triggers and five timers and counters.

1-7. ACCESSORIES

Descriptions of the Interface Pod accessories are located in their respective appendix.

1-8. Accessories Available

HP 18173A	RS-232C/V.24 Interface Pod
HP 18174A	RS-449 Interface Pod
HP 18177A	V.35 Interface Pod
HP 18178A	X.21 Interface Kit
HP 18179A	RS-232C/V.24 Interface Pod with breakout box
HP 18180A	Combination RS-232C/V.24 and RS-449 Interface Pod
HP 18186A	SNA Analysis
HP 18187A	DDCMP Decode/Simulate
HP 18190A	Soft vinyl carrying case for 4951 & one Interface Pod
HP 18193A	X.25 Real-Time Decode
HP 18197A	RS-232C/X.21 Interface Kit
HP 18201A	Asynchronous Terminal Emulator
HP 98200A	Certified blank tape cartridges (set of five)

1-9. OPTIONS

Option 001	Integral Tape Unit
Option 003	Katakana (JIS-7,JIS-8, EBCDIC) Data Codes add HP 18178A Interface Kit
Option 100	Adds accessory HP 18173A
Option 101	Adds accessory HP 18174A
Option 102	Adds accessory HP 18180A
Option 103	Adds accessory HP 18179A
Option 104	Adds HP 18178A Interface Kit
Option 106	Adds HP 18197A Interface Kit
Option 910	Service Manual and Extra Operating Manual
Option 915	Service Manual
Option 916	Extra Operating Manual
Option N00	Software Notification Service

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides information to install and power the HP 4951 Protocol Analyzer. Interface Pod installation information is contained in the respective appendixes.

2-2. INITIAL INSPECTION

Inspect the Protocol Analyzer and accessories for any physical damage sustained in transit. Check that all the items that should accompany the Protocol Analyzer have been received. If accessories are missing or if the unit is received in a damaged condition, notify the nearest HP Sales and Support Office.

2-3. LINE VOLTAGE SELECTION

Before plugging in the HP 4951, check the line voltage selection on the rear panel above the power jack. It should be correctly configured for your area. The type of fuse is also dependent on the line voltage. To select the line voltage, pry open the cover to the line voltage selector on the back of the HP 4951. Remove the wheel, select the correct line voltage, and press the wheel back into place. Close the cover. The fuse does not need to be changed. Table 2-1 lists line voltages and the corresponding HP power cables.

2-4. GROUNDING REQUIREMENTS

The HP 4951 is equipped with a three conductor power cable which when connected to the power outlet, grounds the Protocol Analyzer. Do not operate the Protocol Analyzer from a power outlet that has no ground protection.

2-5. TAGGING FOR SERVICE

If the instrument is returned to Hewlett-Packard for service, complete one of the blue repair tags located in the back of this manual and attach it to the instrument.

2-6. STORAGE AND SHIPMENT

2-7. Original Packaging

Containers and materials identical to those used in factory packaging are available through any Hewlett-Packard Sales offices. If the instrument is returned to Hewlett-Packard for service, complete and attach the blue repair tag. Mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model and serial number.

2-8. Other Packaging

Use these general instructions for packaging with commercially available materials:

1. Wrap the instrument in an antistatic material. If shipping to a Hewlett-Packard Sales or Service Office, include a completed blue repair tag.

2. Use a strong shipping container such as a double wall carton with 275 burst test.

3. Use a layer of shock absorbing material, 70-100 mm (3-4 inches) thick. This provides a firm cushion and prevents movement inside the container.

4. Seal the carton securely and mark it FRAGILE to ensure careful handling.

2-9. TURN ON THE HP 4951

CAUTION

Do not plug in the instrument until you are sure that the line voltage selection is correct.

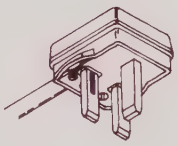
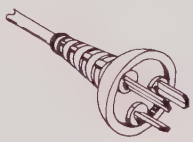
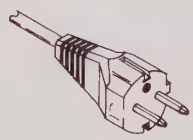
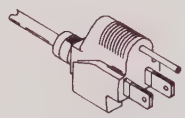
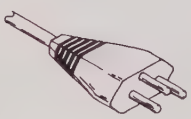
CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

Connect the Interface Pod and press the switch on the back of the instrument to ON. The HP 4951 Protocol Analyzer will automatically perform the Performance Verification test sequence. When the Performance Verification passes, then the top level menu is displayed and the Protocol Analyzer is ready for operation. If the Performance Verification does not pass, refer to the troubleshooting procedure in Section VIII.

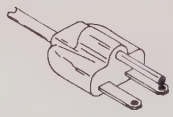
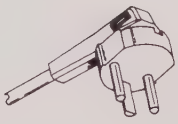
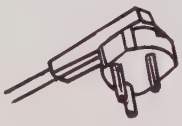
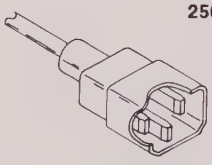
Figure 2-1. Interface Pod Connection

Table 2-1. Power Cable Descriptions

PLUG TYPE	CABLE HP PART NUMBER	CD	PLUG DESCRIPTION	CABLE LENGTH (Inches)	CABLE COLOR	FOR USE IN COUNTRY
250V 	8120-1351 8120-1703	0 6	Straight *BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom Cyprus, Nigeria, Rhodesia, Singapore
250V 	8120-1369 8120-0696	0 4	Straight *NZSS198/ASC112 90°	79 87	Gray Gray	Australia New Zealand
250V 	8120-1689 8120-1692	7 2	Straight *CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Egypt, (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight *NEMA5-15P 90° Straight *NEMA5-15P Straight *NEMA5-15P 90° Straight *NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Japan (100V or 200V), Mexico, Philippines, Saudi Arabia, Taiwan, Canada
250V 	8120-2104	3	Straight *SEV1011 1959-24507 Type 12	79	Gray	Switzerland

* Part number shown for the plug is the industry identifier for the plug only.
The number shown for cable is the HP Part Number for complete cable including the plug.

Table 2-1. Power Cable Descriptions (continued)

PLUG TYPE	CABLE HP PART NUMBER	C D	PLUG DESCRIPTION	CABLE LENGTH (Inches)	CABLE COLOR	FOR USE IN COUNTRY
 250V	8120-0698	6	Straight *NEMA6-15P			United States, Canada
 250V	8120-1957 8120-2956	2 3	Straight *DHCK 107 90°	79 79	Gray Gray	Denmark
 250V	8120-4600 8120-4211	8 7	Straight BS 546/SABS 164 90°	98 98	Black Black	South Africa India
 250V	8120-1860	6	Straight *CEE22-VI (Systems Cabinet Use)			

* Part number shown for the plug is the industry identifier for the plug only.
The number shown for cable is the HP Part Number for complete cable including the plug.

SECTION III
OPERATION

3-1. INTRODUCTION

This section contains a brief description of operating procedures for the HP 4951. Complete operating procedures for the Protocol Analyzer and the Interface Pod accessories are located in the Operating Manual (HP 04951-90023). Abbreviated operating procedures for the Interface Pod accessories HP 18173A, HP 18174A, HP 18178A, HP 18179A, HP 18180A, and HP 18197A are located in the respective appendices.

3-2. OPERATION

Six software defined keys, or softkeys, provide operator access to the capabilities of the HP 4951. When the instrument is turned on, an automatic self test is performed, and the Top Level Menu is displayed. The softkey descriptions appear on the display. Generally, softkeys will be enclosed with < > throughout this manual. Table 3-1 describes the Top Level Menu softkey mnemonics. To select a particular procedure, press the dark gray key on the keyboard corresponding to the softkey displayed on the CRT.

Table 3-1. Top Level Menu

AUTO-CONF	Automatic configuring for on-line monitoring.
SETUP	Manual configuring for monitoring or simulating.
MONITOR	Programs made for monitoring.
SIMULATE	Programs DTE or DCE simulation procedures.
RUN MENU	Executes all tests: monitoring, simulation, or BERT.
EXAMINE DATA	Displays the buffer contents after a test.
MORE	Press MORE on keyboard to display rest of menu.
BERT	Configures Bit Error Rate Tests in conjunction with another HP Protocol Analyzer.
REMOTE	Transmits and receives menu setups and data.
MASS STORE	Provides tape control and catalog functions.
RESET	Sets all menus to the default conditions and clears the buffer.
SELF TEST	Provides access to self test.

The Top Level Menu accesses all of the other menus. The softkeys enable you to perform all of the instrument functions.

EXIT acts like a halt key during a testing sequence. Press EXIT during a test sequence to stop it at any time. The Top Level Menu will be displayed.

Press MORE to see the second or third set of softkeys in any menu. A small vertical MORE appears at the lower right of the CRT to prompt you whenever there is another set of softkeys in any menu.

The memory is nonvolatile. Turn off the Protocol Analyzer only when the display shows the top level menu to save setups, data, and programs.

CAUTION

Always return to the Top Level Menu before turning the instrument power off.

CAUTION

Always turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

4-6. PERFORMANCE VERIFICATION TEST DESCRIPTIONS

The following is a description of the Performance Verification tests done automatically at instrument turn on. They are referenced to the flowchart in Figure 4-1 by the letter preceding each test. Troubleshooting procedures are located in the Service Section.

The Top Level menu is displayed when the instrument passes the Performance Verification tests. If there is a failure, the Failure Table will remain on the display. An 01 will appear in the Failure Column by the failed test. Press HALT(EXIT) to access the Top Level Menu.

A. Turn on Instrument/Microprocessor Wakes Up

Test Failure Code

continuous beep

Description

When the beep stops, the microprocessor and the power supply are working.

B. I/O Timer

Test Failure Code

continuous beep

Description

Checks that the I/O timer is functioning correctly.

C. Dual Port RAM and Arbiter

Test Failure Code

no beep

Description

Tests the operation of dual port RAM and arbiter circuit.

D. CRT CONTROLLER

Test Failure Code

no beep
no CRT display

Description

Checks operation of the deflection circuits.

E. ROM

Test Failure Code

The ROM test is performed once at turn on. If there are any ROM failures, the Failure Table will be displayed.

Description

The microprocessor checks all ROMs (except ROM 0000) and places pass/fail information in memory. If any ROM device fails, the Test Failure Table is displayed. The operator may press EXIT(HALT) to access the Top Level Menu.

F. RAM

Test Failure Code

The RAM test is performed once at turn on. If there are any RAM failures, the Failure Table will be displayed.

Description

The microprocessor checks all RAM and places pass/fail information in memory. If any RAM device fails, the Test Failure Table is displayed. The operator may press EXIT(HALT) to access the Top Level Menu.

G. DATA LINK CONTROL CIRCUITRY (DLC)

Test Failure Code

Number of times the test fails is displayed under FAILURES column.

Description

Microprocessor checks the DLC for proper operation.

H. TAPE I/O

Test Failure Code

Bad tape I/O

Description

Checks digital circuitry

4-7. KEYBOARD TEST

Description

The Keyboard test is performed by the operator. It verifies that the HP 4951 correctly identifies each key pressed on the keyboard.

Setup

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <KBD TEST>.

Procedure

1. Press any key on the keyboard.
2. The display should read:

   LAST KEY PRESSED: "(name of key pressed is displayed)"

NOTE

The cursor down and RETURN keys effectively make the cursor perform the same operation. When the RETURN key is pressed, CURSOR DOWN is displayed.

3. Press HALT(EXIT) to end the test and display the self test menu.

4-8. INTERFACE POD TEST

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. When the <EXT DLC> softkey is pressed, the Interface Pod test is automatically performed.

2. One of the following messages is displayed.

No pod attached

DLC passed

DTE failed

DCE failed

DCE failed
DTE failed

3. If any message other than DLC passed is displayed, the instrument should be sent to a Hewlett-Packard Service Center.

4. Press (HALT)EXIT until the testing stops and the Top Level Menu is displayed.

Table 4-2. Performance Verification Test Record

Date of Test **Operator**		
TEST	**PASS**	**FAIL**
Microprocessor		
I/O Timer		
Dual Port RAM and Arbiter		
CRT Controller		
ROM Numbers of failed ROM:		
RAM Numbers of failed RAM:		
DLC		
Tape I/O		
Interface Pod		
Keyboard		
Number of tests performed		

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustment procedures for the HP 4951 Protocol Analyzer. The adjustments in this section have no affect on the Performance Verification Tests.

5-2. SAFETY CONSIDERATIONS

For your protection and to avoid damage to the instrument, all listed warnings and cautions must be followed. Whenever internal instrument circuits are exposed, exercise caution. Follow the correct procedures for handling static sensitive devices (see paragraph 8-6).

WARNING

8000 volts can be present in the
HP 4951 circuitry even when it is turned off.

5-3. REQUIRED EQUIPMENT

To perform the adjustments use an insulated screwdriver and a hexagonal plastic core adjuster.

WARNING

When adjustments are in the high voltage circuitry,
tools should be insulated or made of non-conductive materials.

Safety glasses should be worn when replacing the CRT.

5-4. INSTRUMENT ACCESS

Access the instrument's internal circuits and assemblies by removing the case top. The case top is secured by four screws located on the bottom of the instrument. Follow the procedure described in the Disassembly Procedure located in Section VIII.

NOTE

Before performing any adjustment, power on HP 4951B and allow it to sit for 30 minutes to warm up.

5-5. ADJUSTMENT PROCEDURES

Adjustments should be performed in the sequence given. There are six adjustment procedures for the HP 4951. The CRT Yoke Centering Ring adjustment should only be performed after repairs have been made in the deflection circuit. The adjustments are as follows:

Intensity Adjustment
Yoke Adjustment
Horizontal Positioning
Vertical Adjustment
Focus Adjustment
Pin Cushion Adjustment

To perform the adjustments, remove the case top as described in paragraph 8-8. Perform the following procedures.

Turn on the HP 4951.

Press MORE.

Select <SELFTEST>.

Select <CRT TSTS>.

Select <TEST PTRN>.

Perform the adjustment procedures.

To exit the test pattern and return to the top level menu, press EXIT (HALT) 3 times.

Figure 5-1 identifies the location of the adjustment points. Figure 5-2 is the test pattern used to perform all adjustments. Perform each adjustment in the order given.

WARNING

8000 volts can be present in the HP 4951 circuitry even when it is turned off.

Wear safety glasses!

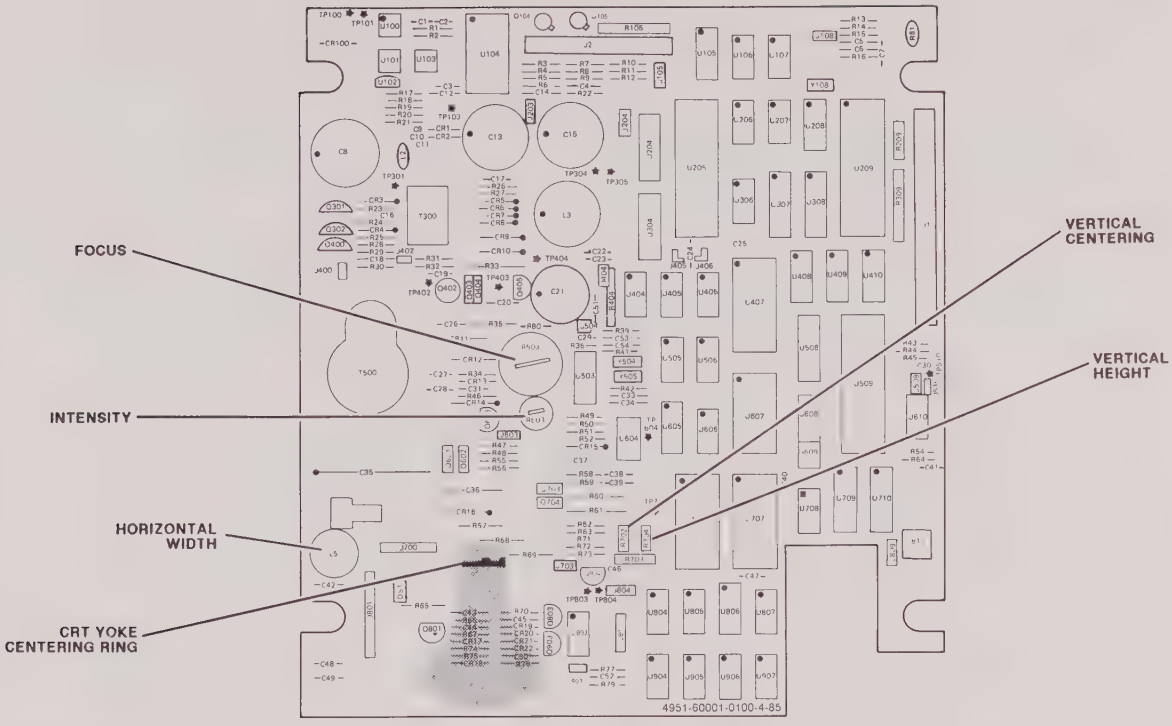


Figure 5-1. HP 4951 Adjustment Points

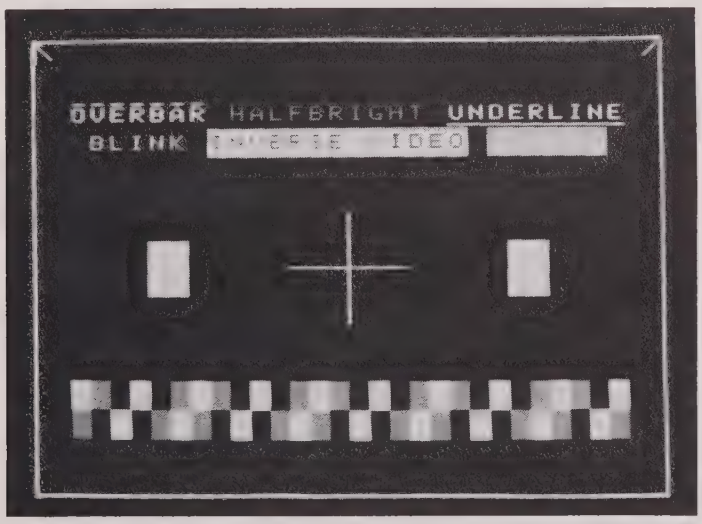


Figure 5-2. HP 4951 Adjustment Test Pattern

5-6. INTENSITY ADJUSTMENT

Description

Adjusts the intensity of the characters on the display and makes the full bright and half bright enhancements distinct from one another.

Procedure

1. With an insulated screwdriver adjust A1R603 so that the brightness level provides a clear distinction between character types on the display.

NOTE

If the CRT has been replaced, it must be burned in for at least 12 hours before adjusting the intensity. To burn in a CRT, press <MORE> and then the softkey next to the <MORE> softkey to obtain a full raster. Allow the unit to operate at least 12 hours. Before the final intensity adjustment allow the unit to operate at least 30 minutes.

5-7. YOKE ADJUSTMENT

Description

This adjustment centers the test pattern on the CRT display. Perform this adjustment only after performing repairs in the deflection circuit. Figure 5-3 shows the location of the centering rings.

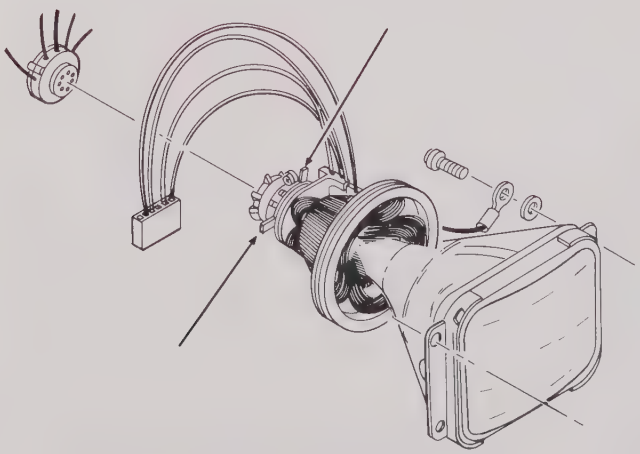


Figure 5-3. CRT Yoke Centering Rings

Procedure

NOTE

This procedure may need to be performed in conjunction with the Horizontal and Vertical Adjustments Procedures to ensure the display is correctly aligned.

1. Loosen the yoke clamp screw to allow the yoke to be rotated.
2. Rotate the yoke to align the vertical and horizontal lines so that they are parallel to the CRT mask.
3. Assure that the yoke is tight against the CRT (forward) and tighten the yoke clamp screw.

CAUTION

Do not over tighten the yoke clamp screw as it is possible to break the CRT neck.

5-8. HORIZONTAL POSITIONING

Description

Adjusts the test pattern width.

Procedure

1. Position the tabs on the CRT yoke centering rings (Figure 5-3) initially at three o'clock and nine o'clock.
2. Adjust the yoke centering rings and A1L5 so the vertical lines of the test pattern are 6MM from each egde of the CRT mask. Both yoke centering rings chould be moved at the same time and in opposite directions, to ensure no vertical movement of the display test pattern.

CAUTION

Use only a plastic core adjuster in A1L5.

5-9. VERTICAL ADJUSTMENT

Description

This adjustment sets the vertical height of the display characters and CRT display.

Procedure

1. While the CRT is in the test pattern mode, adjust A1R704 (vertical height) and A1R702 (vertical center) so that the upper horizontal line is 6MM from the top CRT mask and the lower horizontal line is 3MM from the bottom CRT mask.

5-10. FOCUS ADJUSTMENT

Description

Adjusts the clarity of the characters on the display.

Procedure

1. Adjust A1R503 so that maximum clarity is obtained in the test pattern mode.

5-12. PINCUSHION ADJUSTMENT

Description

Adjusts the outer edges of the display for straight lines.

Procedure

1. Start by using the lowest strength magnet needed (see Table 5-1).

2. Place magnets on the posts of the yoke. Place only enough magnets to obtain straights lines along the border of the test pattern. The location and the rotation of the magnets affect the straightness of the lines on the CRT.

3. After the final adustment of the pincushioning, glue the magnets to the posts of the yoke.

Table 5-1. CRT Yoke Magnets

PART NUMBER	STRENGTH	COLOR
9160-0289	2.5 GAUSS	GREEN
9160-0287	5.0 GAUSS	WHITE
9160-0288	7.5 GAUSS	YELLOW

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering replacement parts. Table 6-1 lists abbreviations used. Table 6-2 is a manufacturer's code list. Tables 6-3 through 6-6 list the mechanical parts and Table 6-8 lists the replaceable parts. Figures 6-1 through 6-4 are exploded views of the instrument.

6-2. REPLACEABLE PARTS LIST

Table 6-8 lists the replaceable parts in alphanumeric order. Information is given for the Description, Quantity (total used in the instrument), HP Part Number, and Manufacturer's Part Number. Chassis and mechanical parts are listed in Tables 6-3 through 6-6.

6-3. ORDERING INFORMATION

To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office. When ordering a part not listed, include the instrument model number, serial number, with a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

6-4. MANUFACTURING INFORMATION

The HP 4951 is manufactured in the United States as well as Europe. To determine the place of manufacture look at the serial number of your instrument. If it has an A in the place shown below it was manufactured in the United States, if it has an F it was manufactured in Europe. The European instruments have a few differences in mechanical and electrical parts which are clearly marked in the parts lists.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	J = electrical connector (stationary portion); jack	TB = terminal board
B = fan; motor	L = coil; inductor	TP = test point
BT = battery	MP = misc. mechanical part	U = integrated circuit; microcircuit
C = capacitor	P = electrical connector (movable portion); plug	V = electron tube; glow lamp
CR = diode; diode thyristor; varactor	Q = transistor; SCR; triode thyristor	VR = voltage regulator; breakdown diode
DL = delay line	R = resistor	W = cable
DS = annunciator; lamp; LED	RT = thermistor	X = socket
E = misc electrical part	S = switch; jumper	Y = crystal unit (piezo-electric or quartz)
F = fuse	T = transformer	
FL = filter		
H = hardware		

ABBREVIATIONS

A = amperes	DIA = diameter	K = kilo (10^3), kilohm
AC = alternating current	DIP = dual in-line package	
ADD = address	DPDT = double-pole, double-throw	LED = light emitting diode
ADJ = adjust, adjustment	DPST = double-pole, single-throw	LFT = left
AL = aluminum	DR = drive	LG = long
AR = as required	DRVR = driver	LH = lefthand
ASM = algorithmic state machine	DSPL = display	LKWR = lockwasher
ASSY = assembly	DTL = diode-transistor logic	LP = low pass
		LS = low power Schottky
B = base	E = emitter	LSB = least significant bit
BCD = binary coded decimal	ECL = emitter-coupled logic	
BeCu = beryllium copper	ELECT = electrolytic	M = milli (10^{-3}), male, mega (10^6), megohm
BIN = binary	ENCAP = encapsulated	MET FLM = metal film
BLK = black	EXT = external	MET OX. = metal oxide
BLU = blue	EXTR = extractor	MHZ = megahertz
BP = band pass		MFR = manufacturer
BRN = brown	F = female, farads	MINTR = miniature
BRS = brass	FF = flip-flop	MISC = miscellaneous
BTU = British thermal unit	FLM = film	MOM = momentary
	FRNT = front	MOS = metal oxide semiconductor
C = collector	FXD = fixed	MSB = most significant bit
CATH = cathode		MTCHD = matched
CCW = counterclockwise	G = giga (10^9)	MTG = mounting
CD PL = cadmium plate	GE = germanium	MTLC = metallic
CER = ceramic	GL = glass	
CERMET = ceramic met flm	GND = ground(ed)	N = nano (10^{-9})
CKTS = circuits	GP = General Purpose	N.C. = normally closed, no connection
C FLM = carbon film	GRA = gray	
CLK = clock	GRN = green	NE = neon
CLR = clear		NO. = number
CMOS = complementary metal oxide semiconductor logic	H = henries	N.O. = normally open
	HDW = hardware	NP = No Polarity
COM = common	HEX = hexagon, hexagonal, six	NPN = negative-positive-negative
COML = commercial	HP = high pass	NPO = negative-positive zero (zero temperature coefficient)
COMP = composition	HR = hour(s)	
COMPL = complete	HZ = Hertz	NRFR = not recommended for field replacement
COND = conductor		
CONN = connector	IC = integrated circuit	NS = normally shorting, nanosecond
CONT = contact	ID = inside diameter	
CPRSN = compression	IF = intermediate frequency	NSR = not separately replaceable
CTL = complementary-transistor logic	IN. = inch, inches	NYL = nylon
	INCAND = incandescent	
CW = clockwise	INCL = include(s)	OBD = order by description
	INSUL = insulation, insulated	OD = outside diameter
D = diameter	INT = internal	ORN = orange
DC = direct current	INTL = internal	
DEPC = deposited carbon		

Table 6-1. Reference Designations and Abbreviations (Continued)

ABBREVIATIONS

P	=	pico (10-12)	RVT	=	rivet	TRN	=	turn
PC	=	printed circuit	RWV	=	reverse working voltage	TTL	=	transistor-transistor logic
PCA	=	printed-circuit assembly				TYP	=	typical
PF	=	picofarad	S	=	second			
PIV	=	Peak Inverse Voltage	SB	=	slow blow	U (μ)	=	micro (10-6)
PK	=	peak	SCR	=	silicon controlled rectifier	UF	=	microfarad
PNL	=	panel	SE	=	selenium	US	=	microseconds
PNP	=	positive-negative-positive	SGL	=	single			
P-P	=	peak-to-peak	SI	=	silicon	V	=	volt(s)
PPM	=	parts per million	SHK	=	shank	VAR	=	variable
POLYC	=	polycarbonate	SIP	=	single in-line package	VCO	=	voltage controlled oscillator
POLYE	=	polyethylene	SKT	=	socket			
POLYSTY	=	polystyrene	SLDR	=	solder	VDCW	=	direct current working volts
PORC	=	porcelain	SPCG	=	spacing	VIO	=	violet
POSN	=	position(s)	SPDT	=	single-pole, double-throw	VNP	=	no polarity voltage
POZI	=	pozidrive	SPST	=	single-pole, single-throw			
PRV	=	peak reverse voltage	SST	=	stainless-steel	W	=	watts
PWV	=	peak working voltage	STL	=	steel	WT	=	weight
P/O	=	part of	SZ	=	size	WW	=	wirewound
						WHT	=	white
R	=	ring	T	=	tip	WIP	=	wiper
RAM	=	random access memory	TA	=	tantalum	WIV	=	working inverse voltage
ROM	=	read only memory	TEL	=	telephone	WSHR	=	washer
RECT	=	rectifier	T.C.	=	Temp. Compensated, temp. coefficient	X	=	times, multiple
RF	=	radio frequency						
RH	=	right hand	THKNS	=	thickness	YEL	=	yellow
RMS	=	root-mean-square	TI	=	titanium			
RND	=	round	TGL	=	toggle	ZNR	=	zener
RT	=	right hand	THD	=	thread			
RTL	=	resistor-transistor logic	THK	=	thick			
RTNT	=	retainer	TOL	=	tolerance	ϕ	=	phi, phase
RTRY	=	rotary	TRMR	=	trimmer			

Table 6-2. Manufacturer's Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
S4013	HITACHI	TOKYO	JP	
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
01456	MICROWAVE DEVELOPMENT LABS INC	NEEDHAM HTS	MA	02194
03888	K D I PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
06383	PANDUIT CORP	TINLEY PARK	IL	60477
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND	OH	44112
1B546	VARO SEMICONDUCTOR INC	GARLAND	TX	75040
12969	UNITRODE CORP	WATERTOWN	MA	02172
17856	SILICONIX INC	SANTA CLARA	CA	95054
19209	GE CO ELEK CAP & BAT PROD DEPT	GAINSVILLE	FL	32601
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	
32293	INTERSIL INC	CUPERTINO	CA	95014
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
5L813	ASHLAND PRODUCTS CO	CHICAGO	IL	60628
51642	CENTRE ENGINEERING INC	STATE COLLEGE	PA	16801
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
71590	CENTRALAB ELEK DIV GLOBE-UNION INC	MILWAUKEE	WI	50501
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE	PA	16512
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108

Table 6-3. Case and Cover Material List

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H1	2520-0014	2	4	SCREW-MACH 8-32, 4 IN LONG	00000	ORDER BY DESCR
H2	5041-6750	2	4	BUMPER FOOT	28480	5041-6750
H3	1460-2098	5	2	SPRING, HANDLE	05502	11058
MP1	04951-40005	3	1	POUCH-SOFT CASE	28480	04951-40005
MP2	5041-6747	7	1	CASE-TOP HALF	28480	5041-6747
MP3	5041-6748	8	1	CASE BOTTOM HALF	28480	5041-6748
MP4	5041-6749	9	1	INTERFACE POD HOUSING	28480	5041-6749
MP5	5040-4470	7	1	HANDLE	28480	5040-4470
MP6	5040-4470	7	2	LABLE, COMES WITH HANDLE	28480	5040-4470
MP7	0424-0458	2	4	SCREW-TPG, 8-16	00000	ORDER BY DESCR

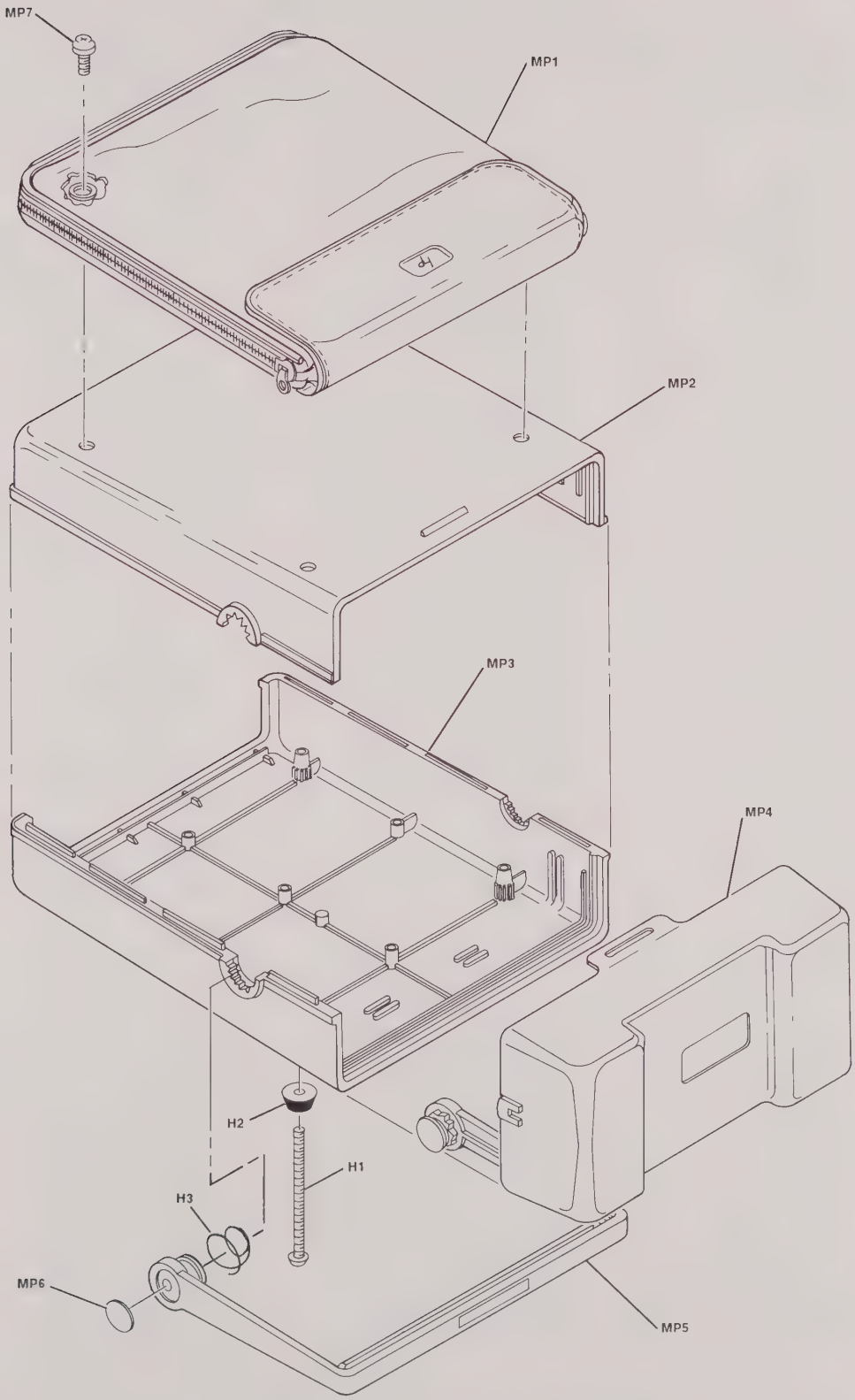


Figure 6-1. Case and Cover Assembly

Table 6-4. Rear Panel Material List

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	04951-62622	3	1	REAR PANEL, COMPLETE ASSY	28480	04951-62622
E1	9135-0256	4	1	LINE-MDL-FILTER 250V,2A	06307	FS 2067
E2	9135-0297	3	1	LINE FILTER-GRENOBLE ONLY	28480	9135-0297
E3	2110-0421	0	1	FUSE	04480	MDL-3/8
H1	2360-0242	8	3	SCR, MCH, 6-32-312	04771	ORDER BY DESCR
H2	2360-0135	8	1	SCR-MACH 6-32, 1.5 IN LONG	05610	ORDER BY DESCR
H3	2190-0007	2	2	WASHER, LOCK	04805	1906-00-00-2580
H4	2190-0018	5	1	WASHER, LOCK	04775	ORDER BY DESCR
H5	2500-0001	5	4	NUT, HEX SS	11227	ORDER BY DESCR
H6	1251-2942	7	4	LOCK BOLT, INC WASHER	00000	ORDER BY DESCR
H7	1251-4580	3	1	CONNECTOR-POST-TP-BDY	01380	640250-3
H8	2200-0144	1	2	SCREW-MACH, 4-40, .375" LONG	01130	ORDER BY DESCR
H9	1251-2942	7	1	LOCK BOLT, INC WASHER	00000	ORDER BY DESCR
H10	2950-0054	1	2	NUT-HEX-DBL-CHAM	04567	318-15-99-011
H11	2190-0069	6	2	WASHER LOCK (FOR 3/8" SCREW)	04805	1820-00
H12	1251-0670	4	1	GOLD CLIPS	03418	08-50-0105
H13	1251-4580	3	1	CONNECTOR	01380	640-250-3
MP1	7100-1288	9	1	TRANSFORMER COVER .62 DP	08391	ORDER BY DESCR
MP2	04951-00008	2	1	BACK PANEL	28480	04951-00008
MP3	5040-4471	8	2	REAR FOOT	28480	5040-4471
MP4	04951-00007	1	1	LINE FILTER SHIELD	28480	04951-00007
MP5	3101-0428	5	1	SWITCH-RKR BASIC DPDT 6A	28480	3101-0428
T1	9100-4366	2	1	POWER TRANSFORMER	28480	9100-4366
W1	04951-61609	7	1	GROUND CABLE	28480	04951-61609
W2	04951-61603	8	1	CABLE, PRINTER VIDEO	28480	04951-61603
W3	04951-61602	1	1	CABLE, MAIN-REAR	28480	04951-61602
W4	04951-61618	2	1	CABLE, POD INTERFACE	28480	04951-61618
W5	5060-7169	9	1	CABLE, BNC EXTERNAL VIDEO	28480	5060-7169
W6	04951-61610	0	1	CABLE, LINE FILTER	28480	04951-61610

Table 6-5. Internal Assemblies Material List

H1	2360-0113	2	4	SCREW-MACH 6-32 .25" LONG	01136	ORDER BY DESCR
H2	1251-8822	4	1	CONN-POST-TP-HDR, 60 CONT	04726	3372-5202
H3	1252-0060	8	1	CONNECTOR 20 POSITION HEADER	04726	3425-5202
H4	1251-7935	8	1	CONN-POST-TP-HDR 8 CONT	03418	2212-2084
H5	1251-4388	9	1	CONN-POST-TP-HDR 3 CONT	03418	22-12-2031
H6	1400-0249	0	1	CABLE TIE .062-.065 DIA	02160	PLTIM-M8
H7	1251-6259	7	1	CONN-POST-TP-HDR 8-CONT	03418	22-29-2081
H8	1251-3751	8	1	CONNECTOR, 8 POSITION HEADER	03418	09-65-1081
H9	1251-3825	7	1	CONNECTOR, 5 POSITION HEADER	03418	09-65-1051
H10	0340-1136	7	4	STANDOFF, BRASS	28480	0340-1136
H11	1251-4246	8	1	CONN-POST-TP-HDR 3-CONT	03418	09-65-1031
H12	1251-8828	0	1	CONN-POST-TP-HDR 40-CONT	04726	3595-6002
H13	0380-1833	5	4	STANDOFF	28480	0380-1833
H14	1252-0217	7	1	CONN-POST-TP-HDR 26-CONT	04726	3429-5202
H15	0380-1197	4	4	STANDOFF-HEX .625" LONG	02121	ORDER BY DESCR
MP1	04951-20007	3	4	SPACER, CASE	28480	04951-20007
W1	04951-61602	0	1	CABLE, MAIN	28480	04951-61602
W2	04951-61617	7	1	CABLE, PRINTER/VIDEO	28480	04951-61617

Table 6-6. Front Panel Material List

H1	0624-0400	8	4	SCREW-TPG 6-19	04771	ORDER BY DESCR
H2	3050-0066	8	4	WASHER, FLAT .147 IN NOM ID	04604	1451
H3	0624-0314	8	4	SCREW-TPG 4-20	05610	224-08150-382
H4	2360-0117	6	2	SCREW-MACH 6-32-375	05610	ORDER BY DESCR
H5	0624-0314	8	6	SCREW-TPG 4-20	05610	224-08150-382
H6	1460-1916	6	2	SPRING-CPRSN	05191	ORDER BY DESCR
H7	04951-20005	1	2	HINGE PIN	28480	04951-20005
H8	1460-1490	1	2	SPRING, HINGE PLATE	05191	LC-042G-5-SS
H9	04951-20004	0	2	HINGE PLATE	28480	04951-20004
H10	04951-20006	2	4	CRT SPACER	28480	04951-20006
H11	1460-1602	7	1	DOOR SPRING	05919	LT-012A-3-L-MW
MP1	04951-62608	8	1	DEFLECTION YOKE	28480	04951-61608
MP2	04951-00002	6	2	TAPE TRANSPORT BRACKET	28480	04951-00002
MP3	04951-62610	2	1	TAPE TRANSPORT ASSEMBLY	28480	04951-62610
MP4	04951-00003	5	1	CRT PANEL	28480	04951-00003
MP5	04951-40001	7	1	FRONT PANEL	28480	04951-40001
MP6	04951-40002	0	1	TAPE COVER	28480	04951-40002
MP7	04951-40003	1	1	KEYBOARD HOUSING, UPPER	28480	04951-40003
MP8	04951-62614	6	1	KEYBOARD	28480	04951-62614
MP9	04951-40004	2	1	KEYBOARD HOUSING, LOWER	28480	04951-40004
MP10	2090-0093	4	1	CRT	28480	2090-0093
MP11	5041-1523	3	1	EJECT BUTTON	28480	5041-1523
MP12	3101-2744	2	64	KEYBOARD SWITCH	28480	3101-2744
W1	04951-61616	6	1	CABLE, CRT	28480	04951-61616
W2	04951-61612	2	1	CABLE, KEYBOARD	28480	04951-61612

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	**04951-60018**	**0**	**1**	**MAIN BOARD (ALL BDS EXCEPT OPT 3)**	**28480**	**04951-60018**
A1C1	0160-0576	5	12	CAP-FXD.1UF +-20% 50VDC CER	28480	0160-0576
A1C2	0160-3508	9	4	CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C3	0160-4822	2	2	CAP-FXD 15PF +-5% 100VDC CER	28480	0160-4822
A1C4	0160-4832	4	1	CAP-FXD.01UF +-10% 100VDC CER	28480	0160-4832
A1C5	0160-4789	0	2	CAP-FXD 15PF +-5% 100VDC CER	28480	0160-4789
A1C6	0160-4789	0		CAP-FXD 15PF +-5% 100VDC CER	28480	0160-4789
A1C7	0180-2683	1	1	CAP-FXD 4.7 UF+-10%35VDC TA	56289	DS10474
A1C8	0180-3374	9	1	CAP-FXD 4700UF+30-10%35VDC AL	28480	0180-3374
A1C9	0160-3879	7	4	CAP-FXD.01UF +-20%100VDC CER	28480	0160-3879
A1C10	0160-3879	7		CAP-FXD.01UF +-20%100VDC CER	28480	0160-3879
A1C11	0160-3508	9		CAP-FXD 1UF+80-20% 50VDC CER	28480	0160-3508
A1C12	0160-4822	2		CAP-FXD 1000PF+-5% 100VDC CER	28480	0160-4822
A1C13	0180-3376	1	2	CAP-FXD 2200UF+30-10% 25VDCAL	28480	0180-3376
A1C14	0160-4824	4	1	CAP-FXD 680PF +-5% 100VDC CER	02798	CAC03COG681J100A
A1C15	0180-3375	0	1	CAP-FXD 3300UF+30-10% 16VDCAL	28480	0180-3375
A1C16	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C17	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C19	0160-2055	9	1	CAP-FXD .01UF 100VDC	04200	C023F101F103ZS22-
A1C20	0160-3879	7		CAP-FXD .01UF +-20%100VDC CER	28480	0160-3879
A1C21	0180-3376	1		CAP-FXD 2200UF+30-10%25VDC AL	28480	0180-3376
A1C22	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C23	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C24	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C25	0160-3508	9		CAP-FXD .1UF +80-20%50VDC CER	28480	0160-3508
A1C26	0160-0996	3	1	CAP-FXD .01UF +-20% 2KVDC CER	72982	828-012-Z5U0-103M
A1C27	0160-4663	7	3	CAP-FXD 2.2UF+80-20%100VDCCER	28480	0160-4663
A1C28	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C29	0160-4953	0	1	CAP-FXD .027UF +-5% 50VDC CER	28480	0160-4953
A1C30	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C31	0160-4663	9		CAP-FXD 2.2UF+80-20%100VDCCER	28480	0160-4663
A1C32	0180-3377	2	1	CAP-FXD 47UF+-20% 50VDC AL	28480	0180-3377
A1C33	0160-4804	4	4	CAP-FXD 56PF +-5% 100VDC CER	02798	CAC03COG681J100A
A1C34	0160-4786	7	2	CAP-FXD 27PF+ 5% 100VDC CER	02798	CAC01COG270J100A
A1C35	0160-3071	1	1	CAP-FXD 10UF +-10% 100VDC	01456	17UB106K
A1C36	0170-0040	9	1	CAP-FXD .047UF +-10% 200VDC	56289	292P47392
A1C37	0160-4579	6	1	CAP-FXD .1UF +-5% 160VDC	28480	0160-4579
A1C38	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C39	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C40	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C41	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C42	0160-4230	6	3	CAP-FXD.01UF+80-20% 1KVDC CER	71590	GAP-103
A1C43	0160-4663	9		CAP-FXD2.2UF+80-20% 100VDCCER	28480	0160-4663
A1C44	0160-4808	4	1	CAP-FXD470PF+-5% 100VDC CER	28480	0160-4808
A1C45	0160-4804	0		CAP-FXD 56PF +-5% 100VDC CER	28480	0160-4804
A1C46	0160-3879	7		CAP-FXD.01UF +-20% 100VDC CER	28480	0160-3879
A1C47	0160-0576	5		CAP-FXD.1UF +-20% 50VDC CER	28480	0160-0576
A1C48	0160-4230	6		CAP-FXD.01UF +80-20% 1KVDCCER	71590	GAP-103
A1C49	0160-4230	6		CAP-FXD.01UF +80-20% 1KVDCCER	71590	GAP-103
A1C50	0160-4804	0		CAP-FXD56PF +-5% 100VDC CER	28480	0160-4804
A1C51	0160-4370	5	1	CAP-FXD100PF +-5% 200VDC CER	51642	200-200-NP0-102J
A1C52	0160-4801	7	1	CAP-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A1C53	0160-4804	0		CAP-FXD 56PF +-5% 100VDC CER	02798	CAC03COG681J100A
A1C54	0160-4786	7		CAP-FXD 27PF +-5% 100VDC CER	02798	CAC01COG270J100A
A1CR1	1901-0871	6	6	DIODE-PWR RECT 1N4002 100V 1A	01295	1N4002
A1CR2	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	01295	1N4002
A1CR3	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A1CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A1CR5	1901-0871	6		DIODE-PWR RECT IN4002 100V 1A	12969	1N4002
A1CR6	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	01295	1N4002
A1CR7	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	12969	1N40023
A1CR8	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	12969	1N4002
A1CR9	1901-0992	2	2	DIODE-SCHOTTKY 1N5822 40V 3A	28480	1901-0992
A1CR10	1901-0992	2		DIODE-SCHOTTKY 1N5822 40V 3A 28480		1901-0992

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1CR11	1901-0845	4	1	DIODE-HV RECT 2KV 50MA 250NS	1B546	VG-2X
A1CR12	1901-1105	1	2	DIODE-HV RECTIFIER	28480	1901-1105
A1CR13	1902-3323	1	1	DIODE ZNR 42.2V 5% PD=.4W	28480	1902-3323
A1CR14	1901-1104	1		DIODE-HV RECTIFIER	28480	1901-1105
A1CR15	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS	28480	1901-0040
A1CR16	1901-0692	9	1	DIODE-PWR RECT 200V 3A 200NS	04713	MR852
A1CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS	28480	1901-0040
A1CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A1CR19	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1CR20	1902-0949	1	1	DIODE-ZNR 4.3V 5% P=.4W	28480	1902-0949
A1CR21	1901-0040	1		DIODE-SWITCH 30V 50MA 2NS	28480	1901-0040
A1CR22	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1CR100	1884-0293	8	1	THYSISTOR-SCR THYR	04713	MCR69-2
A1DS1	2140-0013	5	1	LAMP 5AB-A 70/57VDC 3000UAT-2	08806	5AB-A(NE-23A)
A1J1	1251-8827	9	1	60 POSITION CONN	28480	1251-8827
A1J2	1251-8828	0	1	40 POSITION CONN	28480	1251-8828
A1J105	1258-0209	9	17	JUMPER-REM	01380	513220-2
A1J108	1258-0209	9		JUMPER-REM	01380	513220-2
A1J203	1258-0209	9		JUMPER-REM	01380	513220-2
A1J204	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A1J400	1258-0209	9		JUMPER-REM	01380	531220-2
A1J402	1258-0209	9		JUMPER-REM	01380	513220-2
A1J404	1258-0209	9		JUMPER-REM	01380	1258-0209
A1J405	1258-0209	9		JUMPER-REM	01380	531220-2
A1J406	1258-0209	9		JUMPER-REM	01380	531220-2
A1J504	1258-0209	9		JUMPER-REM	01380	531220-2
A1J509	1248-0209	9		JUMPER-REM	01380	531220-2
A1J510	1248-0209	9		JUMPER-REM	01380	531220-2
A1J603	1258-0209	9		JUMPER-REM	01380	531220-2
A1J608	1251-4292	4	1	SHUNT-DIP 7 POSITIONS	28480	1251-4292
A1J609	1251-4398	1	2	CONNECTOR SHUNT -4 POSITION	28480	1251-4398
A1J700	1251-3825	7	1	CONNECTOR-POST	03418	09-65-1051
A1J703	1258-0209	9		JUMPER-REM	01380	531220-2
A1J801	1251-3751	0	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3751
A1J803	1251-5285	7		JUMPER-REM	03260	65521-102
A1J804	1258-0217	9	1	MULTI-B-JUMP	28480	1258-0217
A1J809	1258-0209			JUMPER-REM	01380	531220-2
A1J810	1251-4398	1		CONNECTOR SHUNT -4 POSITION	28480	1251-4398
A1J903	1251-6259	7	1	CONNECTOR POST TP HDR	28480	1251-6259
A1L2	9140-0801	6	1	TOROIDAL CHOKE	28480	9140-0801
A1L3	04951-80015	9	1	COUPLED INDUCTOR	28480	04951-80015
A1L4	9140-0319	1	1	COIL-LINEARITY	28480	9140-0319
A1L5	9140-0407	8	1	CL-V 10UH MIN	28480	9140-0407
A1Q104	1855-0420	0	2	TRANS J-FET	02883	2N4391
A1Q105	1855-0420	O		TRANS J-FET	02883	2N4391
A1Q301	1854-0215	1	1	TRANS NPN PD=350MW FT=300MHZ	04713	2N3904
A1Q302	1855-0526	9	1	TRANS MFET -CHAN E-MODE SI	28480	1855-0526
A1Q400	1855-0525	8	2	TRANS MFET N-CHAN E-MODE SI	28480	1855-0525
A1Q402	1855-0402	0	1	TRANS J-FET2N5115 P-CH D-MODE	17856	2N5115
A1Q403	1855-0492	8	2	TRANS MFET N-CH E-MODE TO-220	28480	1855-0492
A1Q404	1855-0492	8		TRANS MFET N-CH E-MODE TO-220	28480	1855-0492
A1Q405	1826-0276	5	1	IC 78L05A V RGLTR TO-92	04713	MC78L05ACP
A1Q601	1855-0524	7	2	TRANS MFET N-CH E-MODE TO-220	28480	1855-0524
A1Q602	1855-0524	7		TRANS MFET N-CH E-MODE TO-220	28480	1855-0524
A1Q603	1855-0525	8		TRANS MFET N-CH E-MODE SI	28480	1855-0525
A1Q703	1854-0659	7	1	TRANS NPN SI PD=1.5W FT=50MHZ	04713	MJE180
A1Q704	1853-0436	6	1	TRANS PNP SI PD=1.5W FT=50MHZ	04713	MJE170
A1Q801	1853-0536	7	1	TRANS PNP SI TO-92 PD-350MW	28480	1853-0536
A1Q803	1854-0730	5	2	TRANS NPN SI TO-92	04713	MPS6531
A1Q804	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A1Q903	1854-0730	5		TRANS NPN SI TO-92	04713	MPS6531
A1R1	0757-0288	1	1	RES 9.09K 1% .125W FTC=0+-100	19701	MF4C1/8-TO-9091-F
A1R2	0698-3266	5	2	RES 237K 1% .125W FTC=0+-100	24546	C4-1/8-T0-2373-F
A1R3	0757-0438	3	2	RES 5.11K 1% .125W FTC=0+-100	24546	C4-1/8-TO-5111-F
A1R4	0698-3446	3	1	RES 383 1% .125W FTC=0+-100	24546	C4-1/8-T0-383R-F
A1R5	0698-7929	5	2	RES 9.0K .1% .125W FTC=0+-50	19701	MF4C1/8-T2-9091-B

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R6	0757-0416	7	1	RES 511 1% .125W FTC=0+-100	24546	C4-1/8-TO-511R-F
A1R7	0757-0401	0	4	RES 100 1% .125W FTC=0+-100	24546	C4-1/8-TO-101-F
A1R8	0698-8463	4	1	RES 484.2 .1% .125W FTC=0+-25	28480	0698-8463
A1R9	0699-0589	1	1	RES 34.334K .1% .125W	28480	0699-0589
A1R10	0698-3447	4	1	RES 422 1% .125W FTC=0+-100	24546	C4-1/8-TO-422R-F
A1R11	0757-0442	9	10	RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R12	0757-0465	6	8	RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A1R13	0698-0084	9	3	RES 2.15K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2151-F
A1R14	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R15	0698-8827	4	1	RES 1M 1% .125W FTC=0+-100	28480	0698-8827
A1R16	0698-3266	5		RES 237K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2373-F
A1R17	0698-3441	8	1	RES 215 1% .125W FTC=0+-100	24546	C4-1/8-TO-215R-F
A1R18	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R19	0698-6348	0		RES 3K .1% .1252	24546	C4-1/8-TO-1002-F
A1R20	0698-7929	5		RES 9.09K 1% .125W FTC=0+-100	03290	NC55
A1R21	0698-7842	1	1	RES 26.1K 1% .125W FTC=0+-100	02995	5033R
A1R22	0698-0084	9		RES 2.15K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2151-F
A1R23	0757-0317	7	1	RES 1.33K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1331-F
A1R24	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R25	0757-0346	2	2	RES 10 1% .125W FTC=0+-100	24546	C4-1/8-TO-10R0-F
A1R26	0698-3153	9	1	RES 3.83K 1% .125W FTC=0+-100	24546	C4-1/8-TO-3831-F
A1R27	0757-0438	3		RES 5.11K 1% .125W FTC=0+-100	24546	C4-1/8-TO-5111-F
A1R28	0757-0346	2		RES 10 1% .125W FTC=0+-100	24546	C4-1/8-TO-10R0-F
A1R29	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A1R31	0757-0280	3	4	RES 1K 1% .125W FTC=0+-100-F	05524	CMF-55-1
A1R32	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R33	8110-0179	7		WIRE, RESISTIVE .362 OHM/FT	08696	CUPRON
A1R34	0698-0085	6		RES 2.61K 1% .125W FTC=0+-100	03292	CT4-1/8-TO-2611-F
A1R35	0757-0145	9	2	RES 750K 1% .25W FTC=0+-100	19701	MF52C1/4-TO-7503-F
A1R36	0757-0460	1	1	RES 61.9K 1% .125W FTC=0+-100	24546	C4-1/8 TO-6192-F
A1R39	0698-7880	7	1	RES 28.7K 1% .125W F TC=0+-25	05524	XMD-55-1
A1R41	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R42	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R43	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R44	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R45	0757-0442	9	3	RES 10K 1% .125W FTC=0+-100	02995	5033R
A1R46	0757-0458	7	2	RES 51.1K 1% .125W FTC=0+ 100	24546	C4-1/8-TO-5112-F
A1R47	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A1R48	0698-3430	5	2	RES 21.5 1% .125W FTC=0+-100	03888	PME55-1/8-TO-21R5-F
A1R49	0757-0199	3	2	RES 21.5K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2152-F
A1R50	0757-0458	7		RES 51.1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-5112-F
A1R51	0757-0199	3		RES 21.5K 1% .125W FTC=0+-100	24546	C4 1/8-TO-2152-F
A1R52	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4 1/8-TO-1003-F
A1R54	0757-0442	7		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO 1002 F
A1R55	0757-0424	7	1	RES 1.1K 1% .125W FTC=0+-100	03292	C/4-V8-TO-1101-F
A1R56	0698-0083	8	1	RES 1.96K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1961-F
A1R57	0686-1045	9	3	RES 100K 5% .5W CC FTC=0+-882	01607	EB1045
A1R58	0698-3154	0	1	RES 4.22K 1% .125W FTC=0+-100	24546	C4-1/8-TO-4221-F
A1R59	0757-0420	3	1	RES 17.8 1% .5W FTC=0+-100	24546	C4-1/8-TO-751-F
A1R60	0698-3389	3	1	RES 17.8 1% .5W FTC=0+-100	28480	0698-3389
A1R61	0757-0797	7	1	RES 90.9 1% .5W FTC=0+-100	28480	0757-0797
A1R62	0757-0401	0		RES 100 1% .125W FTC=0+-100	24546	C4-1/8-TO-101-F
A1R63	0698-0084	9		RES 2.15K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2151-F
A1R64	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A1R65	0686-1015	3	1	RES 100 5% .5W CC FTC=0+529	01121	EB1015
A1R66	0757-0401	0		RES 100 1% .125W FTC=0+-100	24546	C4-1/8-TO-101-F
A1R67	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A1R68	0686-1045	9		RES 100K 5% .5W CC FTC=0+882	01121	EB1045
A1R69	0686-1045	9		RES 100K 5% .5W CC FTC=0+882	01121	EB1045
A1R70	0757-0280	3		RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001-F
A1R71	0757-0280	3		RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001-F
A1R72	0698-3161	9	2	RES 30.3K 1% .125W FTC=0+-100	24546	C4-1/8-TO-3832 F
A1R73	0698-3161	9		RES 30.3K 1% .125W FTC=0+-100	24546	C4-1/8-TO-3832-F
A1R74	0757-0401	0		RES 100 1% .125W FTC=0+-100	24546	C4 1/8-TO-101-F
A1R75	0698-3158	4	1	RES 23.7K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2372-F
A1R76	0757-0280	3		RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001-F
A1R77	0698-3430	5		RES 21.5 1% .125W FTC=0+-100	03888	PME55-1/8 TO 21R5-F
A1R79	0757-0465	6	1	RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A1R80	0757-0145	9		RES 750K 1% .25W FTC=0+-100	19701	MF521/4-TO-7503-F
A1R82	0683-1025	9	2	RES 1K 5% .25W	00746	R25J

Table 6-8. Replaceable Parts

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R83	0683-1025	9		RES 1K 5% .25W	00746	R25J
A1R105	1810-0280	8	1	NETWORK-RES 10-SIP 10K OHM X9	06524	C5C10A01-103G
A1R209	1810-0368	3	1	NETWORK-RES 10 SIP 10K OHM X5	02483	750-61-R10K
A1R309	1810-0277	3	1	NETWORK-RES 10-SIP 2K OHM X9	01121	210A222
A1R404	1810-0406	0	1	NETWORK-RES 8-SIP 10.0K OHMX4	01121	208B103
A1R503	2100-3908	9	1	RES-TRMR 1M 10% CC TOP-ADJ	28480	2100-3908
A1R603	2100-3966	9	1	RES-TRMR 200K 10% C TOP-ADJ	28480	2100-3966
A1R702	2100-3096	6	1	RES-TRMR 50K 10% C TOP-ADJ	32997	3292W-1-503
A1R703	1818-0780	9	1	IC NMOS 8192 (8K)	03811	C2708
A1R704	2100-3089	7	1	RES-TRMR 5K 10% C TOP-ADJ	06528	2-552 3292W-1-502
A1T300	04951-80016	0	1	100KHZ TRANSFORMER	28480	04951-80016
A1T500	9100-0453	0	1	XFMR-FLYBACK	28480	9100-0453
A1TP100	1251-8360	5	63	CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP101	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP103	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP301	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP304	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP305	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP402	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP403	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP404	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP510	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP604	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP704	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP803	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP804	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1GND	1251-8360	5		CONN-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1U100	1826-0412	1	1	IC COM PRCN DUAL 8-DIP-P PKG	27014	LM393N
A1U101	1826-0544	0	1	V REF 8-DIP-C	04713	MC1403U
A1U102	1826-0275	4	1	IC 78L2A V RGLTR TO-92	04713	MC78L12ACP
A1U103	1826-0468	7	1	IC COMPARATOR GP 8-DIP-P PKG	04713	MC3423P1
A1U104	1826-1066	3	1	IC-VOLT REG 2A PIN	28480	1826-1066
A1U105	1820-3350	0	1	IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3350
A1U106	1820-3007	4	2	IC GATE CMOS/74HCEXCL-OR QUAD	28480	1820-3007
A1U107	1820-2922	0	4	IC GATE CMOS/74HC NAND QUAD	28480	1820-2922
A1U204	1820-3082	5	4	IC-MC74HC374N	28480	1820-3082
A1U205	1820-3515	9	1	IC Z8530ACS	07653	8530ACS
A1U206	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD	28480	1820-3298
A1U207	1820-3097	2	3	IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1U208	1820-3191	7	4	IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U209	1820-3436	3	1	IC-8-BIT µPROC 4MHZ CLOCK	28480	1820-3436
A1U304	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A1U306	1820-3097	2		IC GATE MOS AND QUAD 2-INP	28480	1820-3097
A1U307	1820-3330	6	1	IC TRANS CMOS/74HC BUS OCTL	28480	1820-3330
A1U308	1820-2998	0	1	IC-MC74HC373N	28480	1820-2998
A1U404	1820-3208	7	1	IC CNTR CMOS/74HC BINASYNCHRO	28480	1820-3208
A1U405	1820-3081	4	4	IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A1U406	1820-3081	4		IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A1U407	1818-3183	9	1	IC CMOS 65536	06347	HM6264LP-15
A1U408	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U409	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U410	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U503	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL DUAL	28480	1820-3373
A1U505	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A1U506	1820-2923	1	1	IC GATE CMOS/74HC NAND TPL	28480	1820-2923
A1U508	1820-3297	4	1	IC DRVR CMOS/74HC BUS OCTL	28480	1820-3297
A1U509	1820-2853	6	1	IC-68A45	02037	MC68A45P
A1U604	126-0753	3	1	IC OPAMP LOW-BIAS-H-INPD QUAD	04713	MC34004BL
A1U605	1820-2925	3	1	IC CNTR CMOS/74HC BIN SYNCHRO	28480	1820-2925
A1U606	1820-2922	0	2	IC GATE CMOS/74HC NAND QUAD	28480	1820-2922
A1U607	1818-1739	9	1	IC CMOS 16384 (16K)	06347	HM6116LP-4
A1U610	1820-2922	0		IC GATE CMOS/74HC NAND QUA	28480	1820-2922
A1U705	04951-10005	0	1	JIS CHAR 1	28480	04951-10005
A1U707	04951-10006	1	1	JIS CHAR 2	28480	04951-10006
A1U708	1820-2921	9		IC INV CMOS HEX	28480	1820-2921
A1U709	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A1U710	1820-3082	5		IC-MC74HC373N	28480	1820-3082

Table 6-8. Replaceable Parts (Replaceable Parts)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1U803	1820-2924	2	1	IC-MC74HC02N	28480	1820-2924
A1U804	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A1U805	1820-3007	4		IC GATE CMOS/74HC EXCL-OR	28480	1820-3007
A1U806	1820-1922	8	1	IC SHF-RGTR TTL PRL-INSER-OUT	01295	SN74LS166N
A1U807	1820-3081	4		IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A1U904	1820-3081	4		IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A1U905	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL	28480	1820-3196
A1U906	1820-2922	0		IC GATE CMOS/74HC NAND QUAD	28480	1820-2922
A1U907	1820-3097	2		IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1XJ105	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ108	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ203	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ400	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ402	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ404	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ405	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ406	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ504	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ509	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ510	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ603	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ608	1200-0638	7		CONNECTOR 2-PIN M POST TYPE	02414	D1LB14P-308T
A1XJ609	1200-0796	8		CONNECTOR 2-PIN M POST TYPE	28480	1200-0796
A1XJ703	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ804	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ809	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ810	1200-0796	8		SOCKET-IC 8-CONT DIP-SLDR	28480	1200-0796
A1XJ903	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XU105	1200-0607	1		SOCKET-IC 16 PIN	28480	1200-0607
A1XU205	1200-0654	7	3	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0654
A1XU209	1200-0654	7		SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0654
A1XU509	1200-0654	7		SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0654
A1XU608	1200-0638	7	1	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0638
A1XU609	1200-0796	8	2	SOCKET-IC 8-CONT DIP-SLDR	28480	1200-0796
A1XU705	1200-0567	1	2	SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A1XU707	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A1XU810	1200-0796	8		SOCKET-IC 8-CONT DIP-SLDR	28480	1200-0796
A1Y108	0410-1520	2	1	XTAL 8.064MHZ	28480	0410-1520
A1Y504	0410-0733	7	1	CRY-QTZ 4.915MHZ HC-18/U-HLDR	04687	MP050
A1Y505	0410-1387	9	1	XTAL 3.6864MHZ	28480	0410-1387
	0380-0566	9	4	STD-RVT-ON	28480	0380-0566
	2200-0105	4	4	SCR-MCH 4-40 PAN-HD-POZI	00000	ORDER BY DESCR.
	2260-0009	3	2	NUT-HEX-W/LKWR 4-40 THD	00000	ORDER BY DESCR.
	4330-0145	9	10	INSULATOR-BEAD GLASS	28480	4330-0145
	04951-61609	1	1	GROUND CABLE	28480	04951-61609
				Substitute the following parts for European manufactured instrument (F in serial prefix)		
A1CR3	1901-1164	2	3	DIODE-SWITCHING 80V 200mA	00046	ORDER BY DESCR
A1CR4	1901-1164	2		DIODE-SWITCHING 80V 200mA	00046	ORDER BY DESCR
A1CR18	1901-1164	2		DIODE-SWITCHING 80V 200mA	00046	ORDER BY DESCR

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19	**04951-60019**	**1**	**1**	**MEMORY BOARD ASSEMBLY**	**28480**	**04951-60019**
A2BT1	1420-0264	1	1	BAT 3.6V .065A-HR NI-CD PIN	02967	41B013AD01401
A2C1	0160-3508	9	7	CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C2	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C3	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C4	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3805
A2C5	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3805
A2C6	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3805
A2C7	0180-0197	8	1	CAP-FXD 2.2 10% 20V	28480	0180-0197
A2C8	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C9	0160-3878	6	1	CAP-FXD 100PF+-20% 100VDC CER	28480	0160-3878
A2C10	0160-4426	2	1	CAP-FXD .01UF +-1% 100VDC CER	28480	0160-4426
A2CR1	1901-1080	1	1	DIODE-SCHOTTKY 1N5817 20V 1A	28480	1901-1080
A2E100	1258-0209	9	2	JUMPER 1X2	01380	531220-2
A2E101	1258-0218	0	4	MULTI-B-JUMP	28480	1258-0218
A2E102	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2E103	1258-0209	9		JUMPER 1X2	28480	1258-0209
A2E104	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2E105	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2J1	1251-8822	4	1	60 POS CONN	28480	1251-8822
A2J2	1200-0607	0	1	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0607
A2R1	0757-0279	0	1	RES 3.16K 1% .125W FTC+0+-100	24325	C4-1/8-TO-3161-F
A2R2	0757-0403	2	1	RES 121% 1% .125W FTC=0+-100	24546	C4-1/8-TO-121R-F
A2R3	0757-0280	3	1	RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001-F
A2R4	0698-3158	4	1	RES 23.7K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2372-F
A2R207	0698-3159	5	1	RES 26.1K 1% .125W FTC=0+-100	03292	CT4-1/8-TO-2612-F
A2R301	1810-0281	9	1	NETWORK-RES 10-SIP 100K X 9	01121	210A104
A2R501	1810-0406	0	3	NETWORK-RES 8-SIP 10K X 4	01121	208B103
A2R502	1810-0406	0		NETWORK-RES 8-SIP 10K X 4	01121	108B103
A2R503	1810-0406	0		NETWORK-RES 8-SIP 10K X 4	01121	108B103
A2S301	9164-0235	0	1	AUD TRANSD PIEZO CERAMIC SOV	28480	9164-0235
A2TP1	1251-8360	5	7	CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2TP2	1251-8360	5		CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2TP3	1251-8360	5		CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2TP4	1251-8360	5		CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2TP300	1251-8360	5		CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2TP301	1251-8360	5		CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2TP400	1251-8360	5		CON-SGL CONTPIN.025-IN-BSC-SZ	28480	1251-8360
A2U100	1818-3183	2	7	IC HM6264 LP-15 RAM	06347	HM626LP-15
A2U101	04951-10021	0	1	MEM PROM 01	28480	04951-10021
A2U103	04951-10022	1	1	MEM PROM 02	28480	04951-10022
A2U104	1818-3183	9		ICM HM 6264	06347	HM6264-15
A2U105	1818-3183	9		ICM HM 6264	06347	HM6264-15
A2U200	04951-10023	2	1	MEM PROM 03	28480	04951-10023
A2U201	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U202	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U203	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U204	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U205	04951-10024	3	1	MEM PROM 04	28480	04951-10024
A2U206	1820-3014	3	2	IC DCDR CMOS 2-TO-4-LINE DUAL	28480	1820-3014
A2U207	1820-3014	3		IC DCDR CMOS 2-TO-4-LINE DUAL	28480	1820-3014
A2U300	1820-3552	4	1	NSC810AN-1-YEMP	28480	1820-3552
A2U301	1820-2998	0	1	IC-MC7411C373N	28480	1820-2998
A2U302	1820-3079	0	1	IC DCDT CMOS/74HC 3-TO-8-LINE	28480	1820-3079
A2U303	1820-2924	2	1	IC-MC74HC02N	28480	1820-2924
A2U304	1820-3082	5	2	IC-MC74HC384N	28480	1820-3082
A2U401	1820-3082	5		IC-MC74HC384N	28480	1820-3082
A2U402	1820-3081	4	2	IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A2U403	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD	28480	1820-3298
A2U404	1820-3208	7	1	IC CNTR CMOS/74HCBIN ASYNCHRO	28480	1820-3208
A2U500	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL	28480	1820-3196
A2U503	1820-3081	4		IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A2U504	1826-1439	4	1	IC TIMER CMOS	01295	TLC555C
A2XE100	1251-4670	2	2	CONN 3-PIN M POST TYPE	28480	1251-4670
A2XE101	1251-8702	9	4	CONN POST.100-PIN-SPGS16-CONT	28480	1251-8702
A2XE102	1251-8702	9		CONN POST.100-PIN-SPGS16-CONT	03206	65610-116

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2XE103	1251-4670	2		CONN 3-IN M POST TYPE	28480	1251-4670
A2XE104	1251-8702	9		CONN-POST.100-PIN-SPCG16-CONT	28480	1251-8702
A2XE105	1251-8702	9		CONN-POST.100-PIN-SPCG16-CONT	28480	1251-8702
A2XU100	1200-0567	1	5	SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU101	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU103	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU200	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU205	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU300	1200-0654	9	1	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0654
	04951-61601	1	1	MAIN/MEMORY CBL	28480	04951-61601
	4330-0145	9	2	INSULATOR BEAD, GLASS	28480	4330-0145

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	**04951-60020**	**4**	**1**	**OPT 001 TAPE CONTROLLER BOARD**	**28480**	**04951-60020**
A3C1	0160-3508	9	5	CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C2	0160-4789	0	2	CAP-FXD 15PF +-10% 200VDC CER	04200	292CC0G150J1008
A3C3	0160-4789	0		CAP-FXD 15PF +-10% 200VDC CER	04200	292CC0G150J1008
A3C4	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C5	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C6	0160-4833	5	1	CAP-FXD.022UF+-10% 100VDC CER	28480	0160-4833
A3C7	0160-3449	7	1	CAP-FXD2000PF+-10% 250VDC CER	28480	0160-3449
A3C8	0160-4567	2	3	CAP-FXD 3900PF+-1% 100VDC CER	28480	0160-4567
A3C9	0160-4535	4	2	CAP-FXD 1UF 10% 50V	28480	0160-4535
A3C10	0160-4567	2		CAP-FXD 3900PF+-1% 100VDC CER	28480	0160-4567
A3C11	0160-4567	2		CAP-FXD 3900PF +-1%100VDC CER	28480	0160-4567
A3C13	0160-3878	0	1	CAP-FXD 1000PF +-5%100VDC CER	02813	CW20A102M3
A3C15	0160-3448	6	1	CAP-FXD 1000PF +-10%1KVDC CER	28480	0160-3448
A3C16	0180-2683	1	1	CAP-FXD 4.7UF +-20% 35VDC CER	02191	MD6-035--475-20/9038
A3C17	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C18	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C19	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C20	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C21	0160-5657	3	1	CAP-FXD 1200PF+-1% 100VDC CER	28480	0160-5657
A3C22	0160-4535	4		CAP-FXD 1UF 10% 50V	28480	0160-4535
A3C23	0160-4801	7	1	CAP-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C24	0160-0576	5		CAP-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C25	0160-3936	7	1	CAP-FXD 700PF+-5% 100VDC CER	28480	0160-3936
A3C26	0160-4808	4	2	CAP-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A3C27	0160-0576	5	1	CAP-FXD .1UF +-5% 50VDC CER	02010	SR205C104MAA
A3C29	0160-4808	4		CAP-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A3C30	0160-3879	7	1	CAP-FXD 1000 +-20% 100VDC CER	02010	SR201C103MAA
A3CR1	1901-0040	1	2	DIODE-SWITCH 30V 50MA 2NS	28480	1901-0040
A3CR2	1901-0040	1		DIODE-SWITCH 30V 50MA 2NS	28480	1901-0040
A3E103	1258-0209	9	7	JUMPER 1 X 2	01380	531220-2
A3E104	1258-0209	9		JUMPER 1 X 2	01380	531220-2
A3E105	1258-0209	9		JUMPER 1 X 2	01380	531220-2
A3E208	1258-0209	9		JUMPER 1 X 2	01380	531220-2
A3E303	1258-0209	9		JUMPER 1 X 2	01380	531220-2
A3E304	3101-2063	8	1	SWITCH-RKR DIP-RKR-ASSY 4-1A	28480	3101-2063
A3E307	1258-0209	9		JUMPER 1 X 2	01380	531220-2
A3E308	1258-0209	9		JUMPER 1 X 2	01380	531220-2
A3J1	1251-8822	4	1	60 POS CONNECTOR	28480	1251-8822
A3J2	1252-0060	8	1	CONN 20 PIN	28480	1252-0060
A3J103	1258-0141	8	8	REMOVABLE JUMPER	28480	1258-0141
A3J104	1258-0141	8		REMOVABLE JUMPER	28480	1258-0141
A3J105	1258-0141	8		REMOVABLE JUMPER	28480	1248-0141
A3J208	1258-0141	8		REMOVABLE JUMPER	28480	1248-0141
A3J303	1258-0141	8		REMOVABLE JUMPER	28480	1248-0141
A3J307	1258-0141	8		REMOVABLE JUMPER	28480	1248-0141
A3J308	1258-0141	8		REMOVABLE JUMPER	28480	1248-0141
A3GND	1258-0141	8		REMOVABLE JUMPER	28480	1258-0141
A3L1	9140-0807	2	2	CHOKE-TOROIDAL	28480	9140-0807
A3L2	9140-0807	2		CHOKE-TOROIDAL	28480	9140-0807
A3Q504	1855-0461	1	2	TRANS MOSFET N-CHAN	28480	1855-0461
A3Q505	1855-0461	1		TRANS MOSFET N-CHAN	28480	1855-0461
A3Q508	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A3Q604	1855-0509	8	2	TRANS MOSFET P-CHAN E-MODE	28480	1855-0509
A3Q605	1855-0509	8		TRANS MOSFET P-CHAN E-MODE	28480	1855-0509
A3Q606	1855-0525	8	1	TRANS MOSFET N-CHAN E-MODE	28480	C4-1/8-TO-1002-F
A3R1	0757-0442	9	13	RES 10K 1% .125W FTC=0+-100	24546	0698-6360 C4-1/8-TO-1002-F
A3R2	0698-6360	6	7	RES 10K .1% .125W FTC=0+-100	25320	5033R
A3R3	0757-0401	0	1	RES 100 1% .125W FTC=0+-100	02995	5033R
A3R4	0757-0280	3	3	RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001-F
A3R5	0757-1094	9	1	RES 1.47K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1471-F
A3R6	0757-0465	6	2	RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A3R7	0757-0465	6		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1003-F
A3R8	0757-0428	1	2	RES 1.62K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1621-F
A3R9	0698-3444	1	2	RES 316 1% .125W FTC=0+-100	24546	C4-1/8-TO-178R-F
A3R10	0698-3444	1		RES 316 1% .125W FTC=0+-100	24546	C4-1/8-TO-178R-F

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R11	0757-0463	4	1	RES 82.5K 1% .125W FTC=0+-100	24546	C4-1/8-TO-8252-F
A3R12	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R13	0757-0438	1	1	RES 5.11K 1% .125W FTC=0+-100	24546	C4-1/8-TO-5111-F
A3R14	0698-3158	4	1	RES 23.7K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2372-F
A3R15	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R16	0698-3439	4	1	RES 178K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1783-F
A3R17	0757-0428	1		RES 1.62K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1621-F
A3R18	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R19	0698-3151	7	2	RES 2.87K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2871-F
A3R20	0698-3266	5	2	RES 237K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2871-F
A3R21	0698-3151	7		RES 2.87K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2871-F
A3R22	0698-3451	0		RES 133K 1% .125W	28480	0698-3451
A3R23	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R24	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A2R25	0698-3266	5		RES 237K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2371-F
A3R26	0698-3260	9	1	RES 464 1% .125W FTC=0+-100	24546	C4-1/8-TO-4641-F
A3R27	0757-3435	0	2	RES 38.3K 2W PW FTC=0+-100	24546	C4-1/8-TO-3831-F
A3R28	0698-0084	9	2	RES 2.15K 1% .125W PW TC=0+-25	28480	0698-0084
A3R29	0698-6413	0	3	RES 6.5K 1% .125W FTC=0+-25	28480	0698-6413
A3R30	0698-6360	6		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-CMF-55-1,T1
A3R31	0698-6360	6		RES 10K .1% .125W FTC=0+-25	28480	0698-6360
A3R32	0698-6360	6		RES 10K 1% .125W FTC=0+-100	28480	0698-6360
A3R33	0698-6360	6		RES 10K 1% .125W FTC=0+-100	28480	0698-6360
A3R34	0757-0280	3		RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001F
A3R35	0698-6413	0	2	RES 6.5K 1% .125W FTC=0+-100	28480	0698-6413
A3R36	0757-0280	3		RES 1K 1% .125W FTC=0+-100	02273	5033R
A3R37	0698-4531	9	1	RES 267K 1% .125W FTC=0+-100	02995	5033R
A3R38	0698-0084	9		RES 2.15K 1% .125W FTC=0+-100	03292	CT4-1/8-TO-2151-F
A3R39	0757-0274	5	1	RES 1.21K 1% .125W FTC=0+-100	03294	CT4-1/8-TO-1211-F
A3R40	0698-3435	0		RES 38.3 1% .125W FTC=0+-100	03294	L04D
A3R41	0698-6413	0		RES 6.5K 1% .125W FTC=0+-100	28480	0698-6413
A3R42	0698-6358	2	2	RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R43	0698-6413	0		RES 6.5K 1% 125W F TC=0+-100	28480	0698-6413
A3R44	0757-0424	7		RES 1.1K 1% .125W	02273	5033R
A3R45	0698-6358	2		RES 100K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R46	8110-0046	1		WIRE, RESISTIVE, .05 FT	28480	8110-0046
A3R47	0698-3452	1	1	RES 147K 1% .125W	03292	CT4-1/8-TO-1471-F
A3R48	0698-6360	6		RESISTOR-FXD 10K 1% .125W	28480	0698-6360
A3R49	0757-0442	9		RES 10K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1002-F
A3R50	0757-0442	9		RES 10K 1% .125W FTC=0+-100	28480	C4-1/8-TO-1002-F
A3R207	1810-0280	8	3	NTW-RES 10-SIP 10.0K OHM X 9	01121	210A103
A3R300	1810-0368	3	2	NTW-RES 6-SIP 10.0K OHM X 5	01121	206A103
A3R307	1810-0280	8		NTW-RES 10-SIP 10.0K OHM X 9	01121	210A103
A3R308	1810-0280	8		NTW-RES 10-SIP10.0K OHM X 9	01121	210A103
A3R404	0698-6360	6		RES 10K .1% .125W FTC=0+-25	28480	0690-6360
A3R505	1810-0368	3		NTW-RES 6-SIP10.0K OHM X 5	01121	206A103
A3R506	1810-0374	1	1	NTW-RES 8-SIP1.0K OHM X 4	01121	208B102
A3U102	04951-10008	3	1	ST MACH PROM 401	28480	04951-10008
A3U103	04951-10027	6	1	TAPE PROM 404	28480	04951-10027
A3U104	1820-3552	4	1	NSC810AN-I-TEMP	28480	1820-3552
A3U105	1820-3058	5	3	IC D-FF CMOS/74HC POS-EDGE	28480	1820-3058
A3U106	1820-2970	8	1	MICROPROCESSOR	28480	1820-2970
A3U201	1820-2923	1	1	IC GATE CMOS/74HC NAND TPL	28480	1820-2923
A3U205	1820-3058	5		IC D-FF CMOS/74 HC POS-EDGE	28480	1820-3058
A2U208	1820-3082	5	3	IC-MC74HC374N	28480	1820-3082
A3U300	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A3U301	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A3U302	04951-10009	4	1	ST MACH PROM 402	28480	04951-10009
A3U303	1820-2232	5	1	IC RGTR CMOS 8-BIT	04713	MC14034BCP
A3U305	1820-3058	5		IC E-FF CMOS/74HC POS-EDGE	28480	1820-3058
A3U306	1820-3185	9	1	IC CMOS/74HC INV HEX	28480	1820-3185
A3U307	1020-2922	0	1	IC GATE CMOS/74H IC NAND QUAD	28480	1820-2922

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U308	1820-3330	6	1	IC TRANS CMOS/74HC BUS OCTL	28480	1820-3330
A3U404	1826-0740	8	1	IC SWITCH ANLG DUAL	32293	IN5043CDE
A3U406	1826-0716	3	1	IC OP AMP LOW-NOISE DUAL	01295	TL072CP
A3U407	1820-3081	4	2	IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A3U408	1820-3081	4		IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A3U504	1820-3377	1	1	IC DRVR CMOS PRPHL HI-CURGATE	28480	1820-3377
A3U505	1826-1039	0	1	IC V RGLTR-SWG 1.1/40V16-CHIP	28480	1826-1039
A3U506	1826-0138	8	1	IC COMPARATOR GP QUAD	01295	LM339N
A3U507	1820-4574	2	2	IC MULTIPLXR 4-CHAN-ANLG DUAL	28480	1820-4574
A3U508	1820-4574	2		IC MULTIPLXR 4-CHAN-ANLG DUAL	28480	1820-4574
A3U607	1826-0753	3	1	IC OP AMP LOW-BIAS-H-IMPDQUAD	04713	MC34004BL
A3XE103	1251-8360	6	19	CONN-SGL CONT PIN .025-IN-BSC	01380	87878-1
A3XE104	1251-8360	6		CONN-SGL CONT PIN .025-IN-BSC	01380	87878-2
A3XE105	1251-8360	6		CONN-SGL CONT PIN .025-IN-BSC	01380	87878-2
A3XE208	1251-8360	6		CONN-SGL CONT PIN .025-IN-BSC	01380	87878-2
A3XE303	1251-8360	6		CONN-SGL CONT PIN .025-IN-BSC	01380	87878-2
A3XE307	1251-8360	6		CONN-SLG CONT PIN .025-IN-BCS	01380	87878-2
A3XE308	1251-8360	6		CONN-SLG CONT PIN .025-IN-BCS	01380	87878-2
A3XJ103	1251-6857	1	5	CONN-POST .100-PIN-SPCG2-CONT	01380	87220-2
A3XJ104	1251-6857	1		CONN-POST TYPE .100-PIN-SPCG	01380	87220-2
A3XJ303	1251-6857	1		CONN-POST TYPE .100-PIN-SPCG	01380	87220-2
A3XJ307	1251-6857	1		CONN-POST TYPE .100-PIN-SPCG	01380	87220-2
A3XJ308	1251-6857	1		CONN-POST TYPE .100-PIN-SPCG	01380	87220-2
A3GND	1251-6857	1		CONN-SLG CONT PIN .025-IN-BCS	01380	87878-2
A3GND	1251-8360	6		CONN-SLG CONT PIN .025-IN-BCS	28480	1251-8360
A3+5	1251-8360	6		CONN-SLG CONT PIN .025-IN-BCS	28480	1251-8360
A3XU102	1200-0541	1	3	SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0541
A3XU103	1200-0541	1		SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0541
A3XU104	1200-0654	7	2	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0654
A3XU106	1200-0654	7		SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0654
A3XU302	1200-0541	1		SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0541
A3Y107	0410-0726	8	1	CRYSTAL-QUARTZ 6.00000 MHZ	28480	0410-0726
	0340-1136	7	1	SPACER-COMPONENT	28480	0340-1136
	0890-0359	9		TUBING-FLEX 0.0500 FT.	28480	0890-0359
	2200-0105	4	2	SCR MCH 4-40 .312	28480	2200-0105
	2260-0009	3	2	NUT-HEX W/LKWR	28480	2260-0009

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4	**04951-60017**	**5**	**1**	**EXTERNAL VIDEO**	**28480**	**04951-60017**
A4C1	0180-0374	3	1	CF 10UF 20V 10%	04200	150D106X9020B2
A4C2	0160-5332	1	17	CAP .1UF 20% 50V	02010	MD015C104MAA
A4C3	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C4	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C5	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C6	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C7	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C8	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C9	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C10	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C11	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C12	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C13	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C14	0180-0291	3	1	CF 1UF 35V	04200	150D106X9020B2
A4C15	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C16	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C105MAA
A4C17	0160-4788	9	1	CAP 18PF 5% 100V	02010	MA101A180JAA
A4C18	0180-2692	2	1	68UF F+-10% 15V	04200	150D686X9015RS
A4C19	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C20	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4C21	0160-5332	1		CAP .1UF 20% 50V	02010	MD015C104MAA
A4CR1	1901-0050	3	3	DIODE SILICON	02237	FDH 63080
A4CR2	1902-0943	5	1	DIO-ZNR 2.40V 5%	02037	SZ30035-001
A4CR3	1901-0050	3		DIODE SILICON	02237	FDH 63080
A4CR4	1901-0050	3		DIODE SILICON	02237	FDH 63080
A4E101	1258-0209	9	9	JUMPER 1 X 2	28480	1258-0209
A4E102	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4E103	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4E104	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4E105	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4E106	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4J2	1252-0217	7	1	CONN 26 PIN	04726	3429-5202
A4J3	1251-4388	9	1	CONN-3 PIN M POST	03418	22-12-2031
A4J4	1251-7935	8	1	CONN PST-TP-HDR	03418	22-12-2084
A4JU404	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4JU506	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4JU608	1258-0209	9		JUMPER 1 X 2	28480	1258-0209
A4L1	9100-1637	4	1	IDCTR 120UH 5%	05826	1537-80
A4P1	1251-8822	4	1	60 POS CONNECTOR	04726	3372-5202
A4Q405	1854-0637	1	1	XSTR NPN2N2219A	02037	2N2219A
A4R1	0683-1565	2	1	RF 15M 5% .25W	01607	CB1565
A4R2	0757-0460	1	1	RF 61.9K 1% .125W	02995	5033R
A4R3	0757-0458	7	1	RF 51.1K 1% .125W	02995	5033R
A4R4	0757-0461	2	1	RF 68.1K 1% .125W	02995	5033R
A4R5	0757-0442	9	7	RF 10K 1% .125W	02995	5033R
A4R6	0698-3440	7	3	RF 196 1% .125W	02995	5033R
A4R7	0698-3440	7		RF 196 1% .125W	02995	5033R
A4R8	0698-3440	7		RF 196 1% .125W	02995	5033R
A4R9	0757-0442	9		RF 10K 1% .125W	02995	5033R
A4R10	0698-3396	2	1	RF 38.3 1% .5W	02995	5033R
A4R11	0698-4853	8	1	RF 226 1% .5W	05524	CMF-65-23
A4R12	0698-3393	9	1	RF 28.7 1% .5W	02995	5033R
A4R13	0757-0401	0	1	RF 100 1% .125W	02995	5033R
A4R14	0757-0443	0	1	RF 11K 1% .125W	02995	5033R
A4R15	0698-3155	1	1	RF 4.64K 1% .125W	02995	5033R
A4R16	0698-0084	9	1	RF 2.15K 1% .125W	02995	5033R
A4R17	0757-0442	9		RF 10K 1% .125W	02995	5033R
A4R18	0757-0442	9		RF 10K 1% .125W	02995	5033R
A4R19	0757-0442	9		RF 10K 1% .125W	02995	5033R
A4R20	0757-0442	9		RF 10K 1% .125W	02995	5033R
A4R21	0757-0442	9		RF 10K 1% .125W	02995	5033R
A4R22	0757-0394	0	1	RF 51.1 1% .125W	02995	5033R
A4R101	1810-0679	9	3	RES NETWK SIP 4	05524	CSC07A-00-S9
A4R102	1810-0679	9		RES NETWK SIP 4	05524	CSC07A-00-S9
A4R103	1810-0679	9		RES NETWK SIP 4	05524	CSC07A-00-S9
A4R205	1810-0206	8	1	NET 10.0K OHM X 7	02483	750-81-R10K

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4TP405	1251-8360	5	16	CONNECTOR POST	28480	1251-8360
A4TP505	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4U104	1826-0759	9	1	IC 339	03406	LM339J
A4U106	1820-1779	3	1	IC MC14411P DGT	02037	MC14411P
A4U108	1820-3176	8	1	IC 74HC151N	02037	MC74HC151N
A4U204	1826-0753	3	1	IC 34004B	02037	MC34004BL
A4U206	1820-3938	0	1	IC HD6350P	06347	HD6350P
A4U208	1820-3082	5	1	IC MC74HC374ND	02037	MC74HC374AN
A4U305	1820-3177	9	1	IC 74HC157N	02037	MC74HC157N
A4U306	1820-3298	5	1	IC74HC32N	02037	MC74HC32N
A4U308	1820-2922	0	2	IC MC74HC00N	02037	SC40291PK
A4U405	1826-0285	6	1	IC MC79L05ACP	03793	SG1502N
A4U506	1820-3208	7	1	IC 74HC393	03046	MM74JC393N
A4U507	1820-2922	0		IC MC74HC00N	02037	SC40292PK
A4U605	1820-2924	2	1	IC MC74HC02N	02037	SC40292PK
A4U606	1820-3463	6	1	IC MM74HC76N	03406	MM74HC76N
A4U607	1820-2925	3	1	IC MC74HC161N	02037	MC74HC161N
A4XE101	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XE102	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XE103	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XE104	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XE105	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XE106	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XJU404	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XJU506	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XJU608	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4XQ405	1200-0173	5	1	PAD XSTR MTG	28480	1200-0173
A4Y1	0410-1004	1		XTAL 1.8432 MHZ	28480	0410-1004
A4GND	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4+5	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4+12	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4-12	1251-8360	5		CONNECTOR POST	28480	1251-8360
A4NC	1251-8360	5		CONNECTOR POST	28480	1251-8360
				Substitute the following parts for Europen manufactured instruments (F in serial prefix)		
A4CR1	1901-1164	2	3	DIODE-SWITCHING 80V 200mA	00046	ORDER BY DESCRIPTION
A4CR3	1901-1164	2		DIODE-SWITCHING 80V 200mA	00046	ORDER BY DESCRIPTION
A4CR4	1901-1164	2		DIODE-SWITCHING 80V 200mA	00046	ORDER BY DESCRIPTION

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21	04951-60021	5	1	JIS MAIN BOARD ASSEMBLY	28480	04951-60021
A1C1	0160-0576	5	12	CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C2	0160-3508	9	4	CAPACITOR-FXD 1UF 50VDC CER	28480	0160-3508
A1C3	0160-4822	2	2	CAPACITOR-FXD 15PF 100VDC CER	28480	0160-4822
A1C4	0160-4832	4	1	CAPACITOR-FXD .01UF100VDC CER	28480	0160-4832
A1C5	0160-4789	0	2	CAPACITOR-FXD 15PF 100VDC CER	28480	0160-4789
A1C6	0160-4789	0		CAPACITOR-FXD 15PF 100VCD CER	28480	0160-4789
A1C7	0180-2683	1	1	CAPACITOR-FXD UF 35VDC TA	56289	DS10474
A1C8	0180-3374	9	1	CAPACITOR-FXD 4700UF 35VDC AL	28480	0180-3374
A1C9	0180-3879	7	5	CAPACITOR-FXD .01UF100VDC CER	28480	0160-3879
A1C10	0180-3879	7		CAPACITOR-FXD .01UF100VDC CER	28480	0160-3879
A1C11	0160-3508	9		CAPACITOR-FXD 1UF 50VDC CER	28480	0160-3508
A1C12	0160-4822	2		CAPACITOR-FXD 1000PF100VDCCER	28480	0160-4822
A1C13	0180-3376	1	2	CAPACITOR-FXD 2200UF 25VDC AL	28480	0180-3376
A1C14	0160-4824	4	1	CAPACITOR-FXD 680PF100VDC CER	02798	CAC03COG681J100A
A1C15	0180-3375	0	1	CAPACITOR-FXD 3300UF 16VDC AL	28480	0180-3375
A1C16	0160-3508	9		CAPACITOR-FXD 1UF 50VDC CER	28480	0160-3508
A1C17	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C19	0160-2055	9		CAPACITOR-FXD .01UF 100VDC	04200	C023F101F103ZS22-CDA
A1C20	0160-3879	7		CAPACITOR-FXD .01UF100VDC CER	28480	0160-3879
A1C21	0180-3376	1		CAPACITOR-FXD 2200UF 25VDC AL	28480	0180-3376
A1C22	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C23	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C24	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C25	0160-3508	9		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-3508
A1C26	0160-0996	3	1	CAPACITOR-FXD .01UF 2KVDC CER	72982	828-012-Z5U0-103M
A1C27	0160-4663	7	3	CAPACITOR-FXD 2.2UF100VDC CER	28480	0160-4663
A1C28	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C29	0160-4953	0	1	CAPACITOR-FXD .027UF50VDC CER	28480	0160-4953
A1C30	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C31	0160-4663	9		CAPACITOR-FXD 2.2UF100VDC CER	28480	0160-4663
A1C32	0180-3377	2	1	CAPACITOR-FXD 47UF 50VDC AL	28480	0180-3377
A1C33	0160-4804	4	2	CAPACITOR-FXD 56PF 100VDC CER	02798	CAC03COG681J100A
A1C34	0160-4786	0	2	CAPACITOR-FXD 56PF 100VDC CER	02798	CAC01COG270J100A
A1C35	0160-3071	1	1	CAPACITOR-FXD 10UF 100VDC	01456	17UB106K
A1C36	0170-0040	9	1	CAPACITOR-FXD .047UF 200VDC	56289	292P47392
A1C37	0160-4579	6	1	CAPACITOR-FXD .1UF 160VDC	28480	0160-4579
A1C38	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C39	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C40	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C41	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C42	0160-4230	6	3	CAPACITOR-FXD .01UF 1KVDC CER	71590	GAP-103
A1C43	0160-4663	9		CAPACITOR-FXD 2.2UF100VDC CER	28480	0160-4663
A1C44	0160-4808	4	1	CAPACITOR-FXD 470PF100VDC CER	28480	0160-4808
A1C45	0160-4804	0		CAPACITOR-FXD 56PF 100VDC CER	28480	0160-4804
A1C46	0160-3879	7		CAPACITOR-FIX .01UF100VDC CER	28480	0160-3879
A1C47	0160-0576	5		CAPACITOR-FXD .1UF 50VDC CER	28480	0160-0576
A1C48	0160-4230	6		CAPACITOR-FXD .01UF 1KVDC CER	71590	GAP-103
A1C49	0160-4230	6		CAPACITOR-FXD .01UF 1KVDC CER	71590	GAP-103
A1C50	0160-4804	0		CAPACITOR-FXD 56PF 100VDC CER	28480	0160-4804
A1C51	0160-4370	5	1	CAPACITOR-FXD100PF 200VDC CER	51642	200-200-NP0-102J
A1C52	0160-4801	7	1	CAPACITOR-FXD 100PF100VDC CER	28480	0160-4801
A1C53	0160-4804	0		CAPACITOR-FXD 56PF 100VDC CER	02798	CAC03COG681J100A
A1C54	0160-4786	7		CAPACITOR-FXD 27PF 100VDC CER	02798	CAC01COG270J100A
A1CR1	0901-0871	6	6	DIODE-PWR RECT 1N4002 100V 1A	01295	1N4002
A1CR2	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	01295	1N4002
A1CR3	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A1CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A1CR5	1901-0871	6		DIODE-PWR RECT IN4002 100V 1A	12969	1N4002
A1CR6	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	01295	1N4002
A1CR7	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	12969	1N40023
A1CR8	1901-0871	6		DIODE-PWR RECT 1N4002 100V 1A	12969	1N4002
A1CR9	1901-0992	2	2	DIODE-SCHOTTKY 1N5822 40V 3A	28480	1901-0992
A1CR10	1901-0992	2		DIODE-SCHOTTKY 1N5822 40V 3A	28480	1901-0992

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1CR11	1901-0845	4	1	DIODE-HV RECT 2KV 50MA 250NS	1B546	VG-2X
A1CR12	1901-1105	1	2	DIODE-HV RECTIFIER	28480	1901-1105
A1CR13	1902-3323	1	1	DIODE ZNR 42.2V 5% D0-35	28480	1902-3323
A1CR14	1901-1105	1		DIODE-HV RECTIFIER	28480	1901-1105
A1CR15	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS	28480	1901-0040
A1CR16	1901-0692	9	1	DIODE-PWR RECT 200V 3A 200NS	04713	MR852
A1CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS	28480	1901-0040
A1CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A1CR19	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1CR20	1902-0949	1	1	DIODE-ZNR 4.3V 5% D0-35	28480	1902-0949
A1CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS	28480	1901-0040
A1CR22	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1CR100	1884-0293	8	1	THYSISTOR-SCR THYR	04713	MCR69-2
A1DS1	2140-0013	5	2	LAMP 5AB-A 70/57VDC 3000UA	08806	5AB-A(NE-23A)
A1J1	1251-8827	9	1	60 POSITION CONN	28480	1251-8827
A1J2	1251-8828	0	1	40 POSITION CONN	28480	1251-8828
A1J105	1258-0209	9	17	JUMPER-REM	28480	1258-0209
A1J108	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J203	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J204	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A1J400	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J402	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J404	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J405	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J406	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J504	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J509	1248-0209	9		JUMPER-REM	28480	1258-0209
A1J510	1248-0209	9		JUMPER-REM	28480	1258-0209
A1J603	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J608	1251-4292	4	1	SHUNT-DIP 7 POSITIONS	28480	1251-4292
A1J609	1251-4398	1	2	CONNECTOR SHUNT -4 POSITION	28480	1251-4398
A1J700	1251-3825	7		CONNECTOR-POST	03418	0965-1051
A1J703	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J801	1251-3751	0	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3751
A1J803	1258 0209	9		JUMPER-REM	28480	1258-0209
A1J803	1251-5286	7	1	CONNECTOR-POST-TYPE-HDR	28480	1251-5286
A1J804	1258-0217	9	1	MULTI-B-JUMP	28480	1258-0217
A1J809	1258-0209	9		JUMPER-REM	28480	1258-0209
A1J810	1251-4398	1		CONNECTOR SHUNT -4 POSITION	28480	1251-4398
A1J903	1251-6259	7	1	CONNECTOR POST TP HDR	28480	1251-6259
A1L2	9140-0801	6	1	TOROIDAL CHOKE	28480	9140-0801
A1L3	04951-80015	9	1	COUPLED INDUCTOR	28480	04951-80015
A1L4	9140-0319	1	1	COIL-LINEARITY	28480	9140-0319
A1L5	9140-0407	8	1	CL-V 10UH MIN	28480	9140-0407
A1Q104	1855-0420	0	2	TRANS J-FET	02993	2N4391
A1Q105	1855-0420	0		TRANS J-FET	02993	2N4391
A1Q301	1854-0215	1	1	TRANS NPN SI PD=350MW	04713	2N3904
A1Q302	1855-0526	9	1	TRANS MOSFET P-CHAN E-MODE SI	28480	1855-0526
A1Q400	1855-0525	8	2	TRANS MOSFET N-CHAN E-MODE SI	28480	1855-0525
A1Q402	1855-0402	0	1	TRANS J-FET 2N5115 D-MODE	17856	2N5115
A1Q403	1855-0492	8	2	TRANS MOSFET E-MODE TO-220	28480	1855-0492
A1Q404	1855-0492	8		TRANS MOSFET E-MODE TO-220	28480	1855-0492
A1Q405	1826-0276	5	1	IC 78L05A V RGLTR TO-92	04713	MC78L05ACP
A1Q601	1855-0524	7	2	TRANS MOSFET E-MODE TO-220	28480	1855-0524
A1Q602	1855-0524	7		TRANS MOSFET E-MODE TO-220	28480	1855-0524
A1Q603	1855-0525	8		TRANS MOSFET E-MODE SI	28480	1855-0525
A1Q703	1854-0659	7	1	TRANS NPNSI PD=1.,5W FT=50MHZ	04713	MJE180
A1Q704	1853-0436	6	1	TRANS PNP SI PD=1.5W FT=50MHZ	04713	MJE170
1Q801	1853-0536	7	1	TRANS PNP SI TO-92 PD-350MW	28480	1853-0536
A1Q803	1854-0730	5	2	TRANSISTOR NPN SI TO-92	04713	MPS6531
A1Q804	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A1Q903	1854-0730	5		TRANSISTOR NPN SI TO-92	04713	MPS6531

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R1	0757-0288	1	1	RESISTOR 9.09K 1% .125W F	19701	MF4C1/8-TO-9091-F
A1R2	0698-3266	5	2	RESISTOR 237K 1% .125W F	24546	C4-1/8-T0-2373-F
A1R3	0757-0438	3	2	RESISTOR 5.11K 1% .125W F	24546	C4-1/8-TO-5111-F
A1R4	0698-3446	3	1	RESISTOR 383 1% .125W F	24546	C4-1/8-T0-383R-F
A1R5	0698-7929	5	2	RESISTOR 9.0K .1% .125W F	19701	MF4C1/8-T2-9091-B
A1R6	0757-0416	7	1	RESISTOR 511 1% .125W F	24546	C4-1/8-TO-511R-F
A1R7	0757-0401	0	4	RESISTOR 100 1% .125W F	24546	C4-1/8-T0-101-F
A1R8	0698-8463	4	1	RESISTOR 484.2 .1% .125W F	28480	0698-8463
A1R9	0699-0589	1	1	RESISTOR 34.334K .1% .125W F	28480	0699-0589
A1R10	0698-3447	4	1	RESISTOR 422 1% .125W F	24546	C4-1/8-TO-422R-F
A1R11	0757-0442	9	10	RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R12	0757-0465	6	8	RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A1R13	0698-0084	9	3	RESISTOR 2.15K 1% .125W F	24546	C4-1/8-TO-2151-F
A1R14	0757-0442	9		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R15	0698-8827	4	1	RESISTOR 1M 1% .125W F	28480	0698-8827
A1R16	0698-3266	5		RESISTOR 237K 1% .125W F	24546	C4-1/8-TO-2373-F
A1R17	0698-3441	8	1	RESISTOR 215 1% .125W F	24546	C4-1/8-TO-215R-F
A1R18	0757-0442	9		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R19	0698-6348	0		RESISTOR 3K .1% .1252	24546	C4-1/8-TO-1002-F
A1R20	0698-7929	5	1	RESISTOR 9.09K 1% .125W F	03290	NC55
A1R21	0698-7842	1		RESISTOR 26.1K 1% .125W F	02995	5033R
A1R22	0698-0084	9		RESISTOR 2.15K 1% .125W F	24546	C4-1/8-TO-2151-F
A1R23	0757-0317	7	1	RESISTOR 1.33K 1% .125W F	24546	C4-1/8-TO-1331-F
A1R24	0757-0442	9		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R25	0757-0346	2	2	RESISTOR 10 1% .125W F	24546	C4-1/8-TO-10R0-F
A1R26	0698-3153	9	1	RESISTOR 3.83K 1% .125W F	24546	C4-1/8-TO-3831-F
A1R27	0757-0438	3		RESISTOR 5.11K 1% .125W F	24546	C4-1/8-TO-5111-F
A1R28	0757-0346	2		RESISTOR 10 1% .125W F	24546	C4-1/8-TO-10R0-F
A1R29	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A1R31	0757-0280	3	4	RESISTOR 1K 1% .125W F	05524	CMF-55-1
A1R32	0757-0442	9		RESISTOR 10K 1% .125W	24546	C4-1/8-TO-1002-F
A1R33	8110-0179	7		WIRE, RESISTIVE .362 OHM/FT	08696	CUPRON
A1R34	0698-0085	6		RESISTOR 2.61K 1% .125W F	03292	CT4-1/8-TO-2611-F
A1R35	0757-0145	9	2	RESISTOR 750K 1% .25W F	19701	MF52C1/4-TO-7503-F
A1R36	0757-0460	1	1	RESISTOR 61.9K 1% .125W F	24546	C4-1/8 TO-6192-F
A1R39	0698-7880	7		RESISTOR 28.7K 1% .125W F	05524	XMD-55-1
A1R41	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R42	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R43	0757-0442	9		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R44	0757-0442	9		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R45	0757-0442	9		RESISTOR 10K 1% .125W F	02995	5033R
A1R46	0757-0458	7	2	RESISTOR 51.1K 1% .125W F	24546	C4-1/8-TO-5112-F
A1R47	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A1R48	0698-3430	5	2	RESISTOR 21.5 1% .125W F	03888	PME55-1/8-TO-21R5-F
A1R49	0757-0199	3	2	RESISTOR 21.5K 1% .125W F	24546	C4-1/8-TO-2152-F
A1R50	0757-0458	7		RESISTOR 51.1K 1% .125W F	24546	C4-1/8-TO-5112-F
A1R51	0757-0199	3		RESISTOR 21.5K 1% .125W F	24546	C4-1/8-TO-2152-F
A1R52	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A1R54	0757-0442	7		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R55	0757-0424	7	1	RESISTOR 1.1K 1% .125W F	03292	C/4-V8-TO-1101-F
A1R56	0698-0083	8	1	RESISTOR 1.96K 1% .125W F	24546	C4-1/8-TO-1961-F
A1R57	0686-1045	9	3	RESISTOR 100K 5% .5W CC	01607	EB1045
A1R58	0698-3154	0	1	RESISTOR 4.22K 1% .125W F	24546	C4-1/8-TO-4221-F
A1R59	0757-0420	3	1	RESISTOR 17.8 1% .5W F	24546	C4-1/8-TO-751-F
A1R60	0698-3389	3	1	RESISTOR 17.8 1% .5W F	28480	0698-3389
A1R61	0757-0797	7	1	RESISTOR 90.9 1% .5W F	28480	0757-0797
A1R62	0757-0401	0		RESISTOR 100 1% .125W F	24546	C4-1/8-TO-101-F
A1R63	0698-0084	9		RESISTOR 2.15K 1% .125W F	24546	C4-1/8-TO-2151-F
A1R64	0757-0442	9		RESISTOR 10K 1% .125W F	24546	C4-1/8-TO-1002-F
A1R65	0686-1015	3	1	RESISTOR 100 5% .5W CC	01121	EB1015
A1R66	0757-0401	0		RESISTOR 100 1% .125W F	24546	C4-1/8-TO-101-F
A1R67	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A1R68	0686-1045	9		RESISTOR 100K 5% .5W CC	01121	EB1045
A1R69	0686-1045	9		RESISTOR 100K 5% .5W CC	01121	EB1045
A1R70	0757-0280	3		RESISTOR 1K 1% .125W F	24546	C4-1/8-TO-1001-F

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R71	0757-0280	3		RESISTOR 1K 1% .125W F	24546	C4-1/8-TO-1001-F
A1R72	0698-3161	9	2	RESISTOR 30.3K 1% .125W F	24546	C4-1/8-TO-3832-F
A1R73	0698-3161	9		RESISTOR 30.3K 1% .125W F	24546	C4-1/8-TO-3832-F
A1R74	0757-0401	0		RESISTOR 100 1% .125W F	24546	C4-1/8-TO-101-F
A1R75	0698-3158	4		RESISTOR 23.7K 1% .125W F	24546	C4-1/8-TO-2372-F
A1R76	0757-0280	3		RESISTOR 1K 1% .125W F	24546	C4-1/8-TO-1001-F
A1R77	0698-3430	5		RESISTOR 21.5 1% .125W F	03888	PME55-1/8-TO-21RS-F
A1R79	0757-0465	6		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A1R80	0757-0145	9		RESISTOR 750K 1% .25W F	19701	MF521/4-TO-7503-F
A1R82	0680-1025	3		RESISTOR 1K 5% .25W	28480	0680-1025
A1R83	0680-1025	3		RESISTOR 1K 5% .25W	28480	0680-1025
A1R105	1810-0280	8	1	NETWORK-RES 10-SIP 10K OHM X9	05524	C5C10A01-103G
A1R209	1810-0368	3		NETWORK-RES 10 SIP 10K OHM X5	02483	750-61-R10K
A1R309	1810-0277	3		NETWORK-RES 10-SIP 2K OHM X9	01121	210A222
A1R404	1810-0406	0	1	NETWORK-RES 8-SIP 10.0K OHMX4	01121	208B103
A1R503	2100-3908	9	1	RES-TRMR 1M10% CCTOP-ADJ	28480	2100-3908
A1R603	2100-3966	9	1	RES-TRMR 200K 10% C TOP-ADJ	28480	2100-3966
A1R607	1818-1738	9		IC CMOS 1638 (16K)	06347	HM6116LP-4
A1R702	2100-3096	6	1	RES-TRMR 50K 10% C TOP-ADJ	32997	3292W-1-503
A1R703	1818-0780	9	1	IC NMOS 8192 (8K)	03811	C2708
A1R704	2100-3089	7	1	RES-TRMR 5K 10% C TOP-ADJ	06528	2-552 3292W-1-502
A1T300	04951-80016	0	1	100KHZ TRANSFORMER	28480	04951-80016
A1T500	9100-0453	0	1	XFMR-FLYBACK	28480	9100-0453
A1TP100	1251-8360	5	62	CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP101	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP103	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP301	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP304	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP305	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP402	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8360
A1TP403	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP404	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP406	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP510	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP604	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP704	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP803	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1TP804	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1GND	1251-8360	5		CON-SGL CONT PIN .025-IN-BSC	28480	1251-8350
A1U100	1826-0412	1	1	IC COMP PRCN DUAL 8-DIP-P PKG	27014	LM393N
A1U101	1826-0544	0	1	V REF 8-DIP-C	04713	MC1403U
A1U102	1826-0275	4	1	IC 78L2A V RGLTR TO-92	04713	MC78L12ACP
A1U103	1826-0468	7	1	IC COMPARATOR GP 8-DIP-P PKG	04713	MC3423P1
A1U104	1826-1066	3	1	IC-VOLTAGE REGULATOR 2A PIN	28480	1826-1066
A1U105	1820-3350	0	1	IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3350
A1U106	1820-3007	4	2	IC GATE CMOS/74HC EXCL-ORQUAD	28480	1820-3007
A1U107	1820-2922	0	4	IC GATE CMOS/74HC NAND QUAD	28480	1820-2922
A1U204	1820-3082	5	4	IC-MC74HC374N	28480	1820-3082
A1U205	1020-3515	9	1	IC Z8530ACS	28480	1820-3515
A1U206	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD	28480	1820-3298
A1U207	1820-3097	2	3	IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1U208	1820-3191	7	4	IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U209	1820-3436	3	1	IC-8-BIT MICROPROCESSOR	28480	1820-3436
A1U304	1820-3082	5	1	IC-MC74HC374N	28480	1820-3082
A1U306	1820-3097	2		IC GATE MOS AND QUAD 2-INP	28480	1820-3097
A1U307	1820-3330	6	1	IC TRANS CMOS/74HC BUS OCTL	28480	1820-3330
A1U308	1820-2998	0	1	IC-MC74HC373N	28480	1820-2998
A1U404	1820-3208	7	1	IC CNTR CMOS/74HCBIN ASYNCHRO	28480	1820-3208
A1U405	1820-3081	4	4	IC FF CMOS/74HC POS-EDGE-TRIG	28480	1820-3081
A1U406	1820-3081	4		IC FF CMOS/74HC POS-EDGE-TRIG	28480	1820-3081
A1U407	1818-3183	9	1	IC 4M6264 LP-15	28480	1818-3183
A1U408	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U409	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191
A1U410	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC	28480	1820-3191

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1U503	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL DUAL	28480	1820-3373
A1U505	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A1U506	1820-2923	1	1	IC GATE CMOS/74HC NAND TPL	28480	1820-2923
A1U508	1820-3297	4	1	IC DRVR CMOS/74HC BUS OCTL	28480	1820-3297
A1U509	1820-2853	6	1	IC-68A45	02037	MC68A45P
A1U604	1826-0753	3	1	IC OP AMPLOW-BIAS-H-INPD QUAD	04713	MC34004BL
A1U605	1820-2925	3	1	IC CNTR CMOS/74HC BIN SYNCHRO	28480	1820-2925
A1U606	1820-2922	0	2	IC GATE CMOS/74HC NAND QUAD	28480	1820-2922
A1U607	1820-2922	9	1	IC CMOS 16384 (16K)	06349	HM6116LP-4
A1U610	1820-2922	0		IC GATE CMOS/74HC NAND QUA	28480	1820-2922
A1U705	04951-10032	3	1	CHAR PROM 111	28480	04951-10032
A1U707	04951-10006	1	1	CHAR PROM 112	28480	04951-10006
A1U708	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A1U709	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A1U710	1820-3082	5		IC-MC74HC373N	28480	1820-3082
A1U803	1820-2924	2	1	IC-MC74HC02N	28480	1820-2924
A1U804	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A1U805	1820-3007	4		IC GATECMOS/74HC EXCL-OR QUAD	28480	1820-3007
A1U806	1820-1922	8	1	IC SHF-RGTR TTL LS	01295	SN74LS166N
A1U807	1820-3081	4		IC FF CMOS/74HC D-TYPE	28480	1820-3081
A1U904	1820-3081	4		IC FF CMOS/74HC D-TYPE	28480	1820-3081
A1U905	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL	28480	1820-3196
A1U906	1820-2922	0		IC GATE CMOS/74HC NAND QUAD	28480	1820-2922
A1U907	1820-3097	2		IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1XJ105	1251-8360	5	17	CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ108	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ203	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ400	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ402	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ404	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ405	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ406	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ504	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ509	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ510	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ603	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ608	1251-8360	5	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ703	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ703	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ804	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ804	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
A1XJ809	1251-8360	5		CONNECTOR 2-PIN M POST TYPE	28480	1251-8360
		5				
A1XU105	1200-0607	1		SOCKET 16 PIN	28480	1200-0607
A1XU205	1200-0654	7	3	SOCKET-IC 40-CONTDIP DIP-SLDR	28480	1200-0654
A1XU209	1200-0654	7		SOCKET-IC 40-CONTDIP DIP-SLDR	28480	1200-0654
A1XU509	1200-0654	7		SOCKET-IC 40-CONTDIP DIP-SLDR	28480	1200-0654
A1XU608	1200-0638	7	1	SOCKET-IC 14-CONTDIP DIP-SLDR	28480	1200-0638
A1XU609	1200-0796	8	2	SOCKET-IC 8-CONTDIP DIP-SLDR	28480	1200-0796
A1XU705	1200-0567	1	2	SOCKET-IC 28-CONTDIP DIP-SLDR	28480	1200-0567
A1XU707	1200-0567	1		SOCKET-IC 28-CONTDIP DIP-SLDR	28480	1200-0567
A1XU810	1200-0796	8		SOCKET-IC 8-CONT DIP DIP-SLDR	28480	1200-0796
A1XY108	0340-1136	7	3	SPACER-COMPONENT	28480	0340-1136
A1XY504	0340-1136	7		SPACER-COMPONENT	28480	0340-1136
A2XY505	0340-1136	7		SPACER-COMPONENT	28480	0340-1136
A1Y108	0410-1520	2	1	XTAL 8.064MHZ	28480	0410-1520
A1Y504	0410-0733	7	1	CRY-QUARTZ 5.0688 MHZ	28480	0410-0733
A1Y505	0410-1387	9	1	XTAL 3.6864MHZ	28480	0410-1387
	0380-0566	7	4	STDF-RVT-ON	28480	0380-0566
	2200-0105	4	2	SCREW-MACH 4-40 .312-IN-LG	00000	ORDER BY DESCR
	2260-0009	3	2	NUT-HEX-W/LKWR 4-40 THD	00000	ORDER BY DESR
	4330-0145	9	10	INSULATOR-BEAD GLASS	28480	4330-0145

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13	**04951-60022**	**6**	**1**	**JIS MEMORY BOARD ASSEMBLY**	**28480**	**04951-60022**
A2BT1	1420-0264	1	1	BAT 3.6V .065A-HR NI-CD PIN	02967	41B013AD01401
A2C1	0160-3508	9	7	CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C2	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C3	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C4	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3805
A2C5	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3805
A2C6	0160-3508	9		CAP-FXD 1UF +80-20% 50VDC CER	28480	0160-3805
A2C7	0180-0197	8	1	CAP-FXD 2.2 10% 20V	28480	0180-0197
A2C8	0160-3508	9		CAP-FXD 1UF+80-20% 50VDC CER	28480	0160-3508
A2C9	0160-3878	6	1	CAP-FXD 100PF+-20% 100VDC CER	28480	0160-3878
A2C10	0160-4426	2	1	CAP-FXD .01UF +-1% 100VDC CER	28480	0160-4426
A2CR1	1901-1080	1	1	DIODE-SCHOTTKY 1N5817 20V 1A	28480	1901-1080
A2E100	1258-0209	9	2	JUMPER 1 X 2	28480	1258-0209
A2E101	1258-0218	0	4	MULTI-B-JUMP	28480	1258-0218
A2E102	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2E103	1258-0209	9	1	JUMPER 1 X 2	28480	1258-0209
A2E104	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2E105	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2J1	1251-8822	4	1	60 POS CONNECTOR	28480	1251-8822
A2J2	1200-0607	0	1	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0607
A2R1	0757-0279	0	1	RES 3.16K 1% .125W FTC+0+-100	24325	C4-1/8-TO-3161-F
A2R2	0757-0403	2	1	RES 121% 1% .125W FTC=0+-100	24546	C4-1/8-TO-121R-F
A2R3	0757-0280	3	1	RES 1K 1% .125W FTC=0+-100	24546	C4-1/8-TO-1001-F
A2R4	0698-3158	4	1	RES 23.7K 1% .125W FTC=0+-100	24546	C4-1/8-TO-2372-F
A2R207	0698-3159	5	1	RES 26.1K 1% .125W FTC=0+-100	03292	CT4-1/8-TO-2612-F
A2R301	1810-0281	9	1	NTW-RES 10-SIP 100K OHM X 9	01121	210A104
A2R501	1810-0406	0	3	NTW-RES 8-SIP 10K OHM X 4	01121	208B103
A2R502	1810-0406	0		NTW-RES 8-SIP 10K OHM X 4	01121	108B103
A2R503	1810-0406	0		NTW-RES 8-SIP 10K OHM X 4	01121	108B103
A2S301	9164-0235	0	1	AUDIO TRANSD CERAMIC TYPE;SOV	28480	9164-0235
A2TP1	1251-8360	5	7	CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2TP2	1251-8360	5		CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2TP3	1251-8360	5		CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2TP4	1251-8360	5		CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2TP300	1251-8360	5		CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2TP301	1251-8360	5		CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2TP400	1251-8360	5		CONN-SGL PIN .025-IN-BSC-SZSQ	28480	1251-8360
A2U100	1818-3183	2	7	IC HM6264 LP-15 RAM	06347	HM626LP-15
A2U101	04951-10028	7	1	MEM PROM 01 JIS	28480	04951-10028
A2U103	04951-10029	8	1	MEM PROM 02 JIS	28480	04951-10029
A2U104	1818-3183	9		ICM HM 6264	06347	HM6264-15
A2U105	1818-3183	9		ICM HM 6264	06347	HM6264-15
A2U200	04951-10030	1	1	MEM PROM 03-JIS	28480	04951-10030
A2U201	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U202	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U203	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U204	1818-3183	9		ICM HM 6264	06347	HM6264P-15
A2U205	04951-10031	2	1	MEM PROM 04 JIS	28480	04951-10031
A2U206	1820-3014	3	2	IC DCDR CMOS 2-TO-4-LINE DUAL	28480	1820-3014
A2U207	1820-3014	3		IC DCDR CMOS 2-TO-4-LINE DUAL	28480	1820-3014
A2U300	1820-3552	4	1	NSC810AN-1-YEMP	28480	1820-3552
A2U301	1820-2998	0	1	IC-MC7411C373N	28480	1820-2998
A2U302	1820-3079	0	1	IC DCDT CMOS/74HC 3-TO-8-LINE	28480	1820-3079
A2U303	1820-2924	2	1	IC-MC74HC02N	28480	1820-2924
A2U304	1820-3082	5	2	IC-MC74HC384N	28480	1820-3082
A2U401	1820-3082	5		IC-MC74HC384N	28480	1820-3082
A2U402	1820-3081	4	2	IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A2U403	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD	28480	1820-3298
A2U404	1820-3208	7	1	IC CNTR CMOS/74HC BINASYNCHRO	28480	1820-3208
A2U500	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL	28480	1820-3196
A2U503	1820-3081	4		IC D-FF CMOS/74HC POS-EDGE	28480	1820-3081
A2U504	1826-1439	4	1	IC TIMER CMOS	01295	TLC55CP
A2XE100	1251-4670	2	2	CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
A2XE101	1251-8702	9	4	CONN POST.100-PIN-SPGS16-CONT	28480	1251-8702
A2XE102	1251-8702	9		CONN POST.100-PIN-SPGS16-CONT	28480	1251-8702

Table 6-8. Replaceable Parts (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2XE103	1251-4670	2		CONNECTOR 3-IN M POST TYPE	28480	1251-4670
A2XE104	1251-8702	9		CONN-POST.100-PIN-SPCG16-CONT	28480	1251-8702
A2XE105	1251-8702	9		CONN-POST.100-PIN-SPCG16-CONT	28480	1251-8702
A2XU100	1200-0567	1	5	SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU101	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU103	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU200	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU205	1200-0567	1		SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0567
A2XU300	1200-0654	9	1	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0654
	04951-61601	1	1	MAIN/MEMORY CBL	28480	04951-61601
	4330-0145	9	1	INSULATOR BEAD, GLASS	28480	4330-0145

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section contains information to backdate this manual for instruments with serial prefix numbers lower than the Serial Prefix shown on the Title Page. It may also contain information about compatibility with other Protocol Analyzer software.

This section **also** contains change information for the HP 4951A.

N O T E

The first part of this section contains changes for the HP 4951B.
The second part of this section contains changes for the HP 4951A.

7-2. MANUAL CHANGES

To adapt this manual to your instrument, make changes to your HP 4951B as listed in Table 7-1. Changes are listed by serial prefix number. The sequence of changes should be performed in the order shown.

For HP 4951B's with serial prefixes greater than the Serial Prefix shown on the Title Page, any changes are described in a yellow MANUAL CHANGES supplement.

Table 7-1. Manual Changes

Instrument Serial No.	Make Changes Changes
No changes at this time	

7-3. PART I: BACKDATING FOR THE HP 4951B

Backdating information in this section is **ONLY** for the HP 4951B Protocol Analyzer.

There are no changes at this time.

7-4. PART II: BACKDATING FOR THE HP 4951A

The following information is included for your reference and to help you be assured that your older HP 4951A has all of the engineering improvements.

CAUTION

DO NOT use any of this backdating information for your HP 4951B.

7-5. ERRATA

The following section contains corrections **ONLY** for the **HP 4951A Service Manual** (HP Part Number 04951-90008).

Page 1-4, Paragraph 1-3. Safety Considerations
Add: This is a Safety Class I product which must be connected to a protected earth ground.

Page 2-1, Paragraph 2-3. Line Voltage Selection
Replace with the following:

Before plugging in the HP 4951A, check the line voltage selection on the rear panel above the power jack. It should be correctly configured for your area. The type of fuse is also dependent on the line voltage. To select the line voltage, pry open the cover to the line voltage selector on the back of the HP 4951A. Remove the wheel, select the correct line voltage, and press the wheel back into place. Close the cover. The fuse does not need to be changed. Table 2-1 lists line voltages and the corresponding HP power cables.

Page 4-2, Table 4-1. Failure Display
Add the following note:

NOTE

The printer/video test will always fail since this feature is available only in the HP 4951B.

Page 6-4, Table 6-3. HP 4951A Case and Cover

Change MP2 to 5041-6747 Case Top Half, CD=7, MFR CODE 28480, MFR P/N 5041-6747

Change MP3 to 5041-6748 Case Bottom Half, CD=8, MFR CODE 28480, MFR P/N 5041-6748

Change MP8 to 0403-0414 Bumper Foot, CD=6, MFR CODE 06560, MFR P/N 9026-P

Page 6-6, Table 6-4. HP 4951A Rear Panel Assembly

Add 1251-5437 Replacement Clips and Screws for 04951-61604, CD=1, MFR CODE 01380, MFR P/N 205980-1

Page 6-6, Table 6-5. HP 4951A Internal Assemblies

Change H25 to 0380-1150 STDF-Hex .75 in, CD=9, MFR CODE 0000, MFR P/N ORDER BY DESCRIPTION

Page 6-6, Table 6-6. HP Front Panel Assemblies

Change W9 to 04951-61616 Deflection Cable, CD=6, MFR CODE 28480, MFR P/N 04951-61616

Add H15 3101-2744 Switch, pushbutton, CD=2, MFR CODE 01870, MFR P/N M81E-0500

Page 6-8, Figure 6-5. HP 4951A Keyboard Assembly

Change L,FF to 5041-6722
Change M,CR to 5041-6723
Change N,SO to 5041-6724
Change O,SI to 5041-6725

Add 5040-4481 Space Bar, CD=0, MFR CODE 28480, MFR P/N 5040-4481

Page 6-9, Table 6-7. Replaceable Parts

Change A2CR2 to 1901-0871 Diode-pwr rect IN4002 100V 1A D0-41, CD=6, MFR CODE 01295, MFR P/N IN4002

Page 6-14, Table 6-7. Replaceable Parts (cont)

Replace A3R3 with 0757-0401 Resistor 100 ohm 1% CD=0, MFR CODE 24546, MFR P/N C4-1/8-TO-101-F

Page 6-15, Table 6-7. Replaceable Parts
Change the Tape Transport to 04951-62610, CD=2, MFG CODE 28480,
MFG P/N 04951-62610

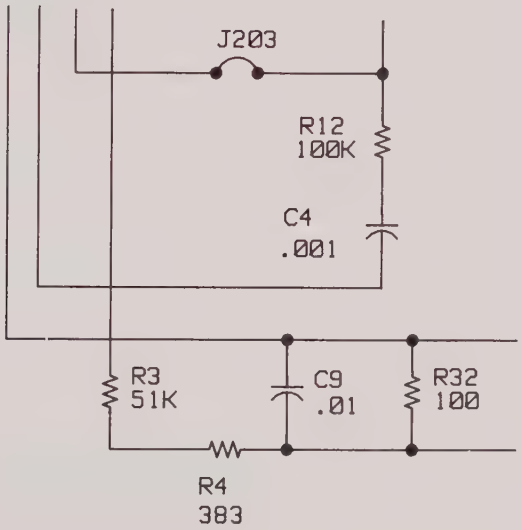
Page 8-3. Paragraph 8-7. Disassembly/Assembly Procedures
Add:

WARNING

Opening the HP 4951A case or removal of internal parts will expose live parts. Disconnect the instrument from all voltage sources before opening for any adjustments, replacements, maintenance, or repairs.

Page 8-17, Paragraph 8-18. CRT Controller (CRTC) RAM
Change A2U508 to A1U508

Page 8-73, Figure 8-15. A1 Power Supply Schematic
Add the following schematic correction:



Page 8-75, Figure 8-18. A1 CPU and DLC Schematic
Reverse the pin number designations on R209 (10K). Pin 5 is tied to U207 pin 4 and pin 4 goes to ground.

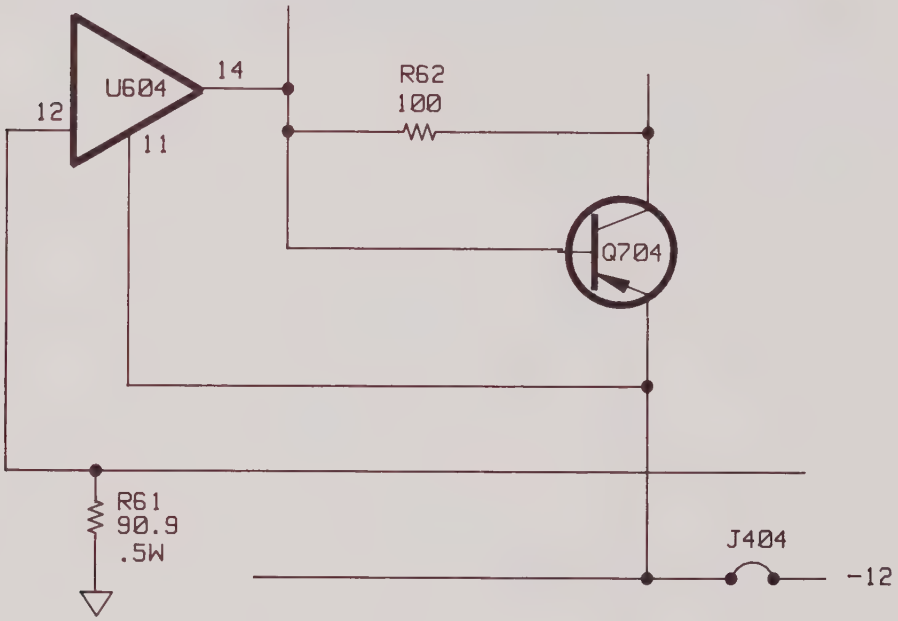
Page 8-81, Figure 8-26. A1 CRT Controller Schematic
Change the pin number designation on R703 (100K) from 6 to 5.

On the left side of the schematic the C/S line is shown as pin 4 of J1, change this to pin 40 of J1.

Page 8-85. Figure 8-30. A1 Deflection Circuit Schematic
Change C14 (.027) to C19, it is located off of pin 14 of U503.

Change the value of C31 to 2.2.

Change the circuit connection from U604 pin 11 as shown below:



Page 8-93, Figure 8-36. A3 Read Amplifier and Speed control Schematic
Change the description of the RD/WR line (from schematic 9, YY) to

$RD/\overline{WR}$

Change the description of the FORWARD/REV line (from schematic 9, UU) to

$\overline{FORWARD}/REV$

Delete C12

Change the value of C26 from 2200 pF to 470 pF
Change the value of C29 from 330 pF to 470 pF
Change the value of R47 from 133K to 147K

Page B-4, Figure B-2. HP 18173A Exploded View

Change H1 to 1251-2942 Lock-submin D conn, CD=7, MFG CODE 04507
MFG P/N 318-15-99-011

Add 18173-80002 Caution Label, CD=7,
MFR CODE 28480, MFR P/N 18173-80002

Page C-4, Figure C-2. HP 18174A Exploded View

Change H2 to 1251-2942 Lock-submin D conn, CD=7, MFG CODE 04507
MFG P/N 318-15-99-011

Page C-5, Table C-2. HP 18174A Replaceable Parts List

Change A1R304 to 1810-0780 Resistor-network 100 K x 5 CD=3
MFR CODE 28480, MFR P/N 1810-0780

Change A1R405 to 1810-0780 Resistor-network 100K x 5 CD=3
MFR CODE 28480, MFR P/N 1810-0780

Page D-4, Figure D-2. HP 18180A Exploded View

Change H2 to 1251-2942 Lock-submin D conn, CD=7, MFG CODE 04507
MFG P/N 318-15-99-011

Change the second W2 Reference Designator in the Parts List to W3.

Page E-12, Paragraph E-20. Procedure

Add 2b as follows:

2b. On the HP 4951A CRT, DTE should display the message "CTS ON, CTS OFF". Lines RTS, CTS, DSR, and CD should be active.

Page E-16, Paragraph E-22. Procedure

Add 3b as follows:

3b. On the HP 4951A CRT, DTE/DCE should display the message "CTS OFF, CTS ON". All of the other lines should be active.

7-6. CHANGE 1: Instruments with serial prefix 2443 or lower

Page 6-6, Table 6-4. HP 4951A Rear Panel Assembly

Change: E1 9135-0224 to 9135-0256 Line Filter, CD=4,
MFR CODE 28480, MFR P/N 9135-0256

Add: 9170-1136 Core shld bead (goes on line filter), CD=5,
MFR CODE 28480, MFR P/N 9170-1136

Page 6-6, Table 6-6. HP 4951A Front Panel Assembly

Change: E4 to 04951-62608 Deflection Yoke, CD=8,
MFR CODE 28480, MFR P/N 04951-62608

Change: W5 to 04951-61612 Keyboard Cable, CD=6,
MFR CODE 28480, MFR P/N 04951-61612

Change: H10 to 0624-0314 Screw, metal 6-32, .5in CD=3,
MFR CODE 05610, MFR P/N 224-08150-382

Page 6-9, Table 6-7. Replaceable Parts

Change: A1 to 04951-60014 Main Board, all options, CD=6,
MFR CODE 28480, MFR P/N 04951-60014

Page 6-11, Table 6-7. Replaceable Parts

Change: A1R81 to 0683-1025 RESISTOR 1K 5% .25W, CD=9,
MFR CODE 00746, MFR P/N R-255

Page 6-14, Table 6-7, Replaceable Parts

Delete: A3C12

Change: A3R9 to 0698-3444 RESISTOR 316 ohm 1% .125W CD=1,
MFR CODE 03292, MFR P/N CT4-1/8-316R-F

Change: A3R10 to 0698-3444 RESISTOR 316 ohm 1% .125W CD=1,
MFR CODE 03292, MFR P/N CT4-1/8-316R-F

Page 6-15, Table 6-7. Replaceable Parts

Change A3U406 to 1826-0716 IC LINEAR OP AMP CD=8,
MFR CODE 02910, MFR P/N NE5532AFE

Page 8-93, Figure A3 Read Amplifier and Speed Control Schematic

Change the values of R9 and R10 (by the Analog Switch) to 316 ohms
Delete C12 (output of U406

7-7. CHANGE 2: Instruments with serial prefix 2451A or lower

Page 6-14, Table 6-7. Replaceable Parts (cont)

Add A3E103 1251-6857 CONN-POST-TP-HDR, CD=1, MFR CODE 01380
MFR P/N 87220-2

Add A3E303 1251-6857 CONN-POST-TP-HDR, CD=1, MFR CODE 01380
MFR P/N 87220-2

Add A3E307 1251-6857 CONN-POST-TP-HDR, CD=1, MFR CODE 01380
MFR P/N 87220-2

Add A3E308 1251-6857 CONN-POST-TP-HDR, CD=1, MFR CODE 01380
MFR P/N 87220-2

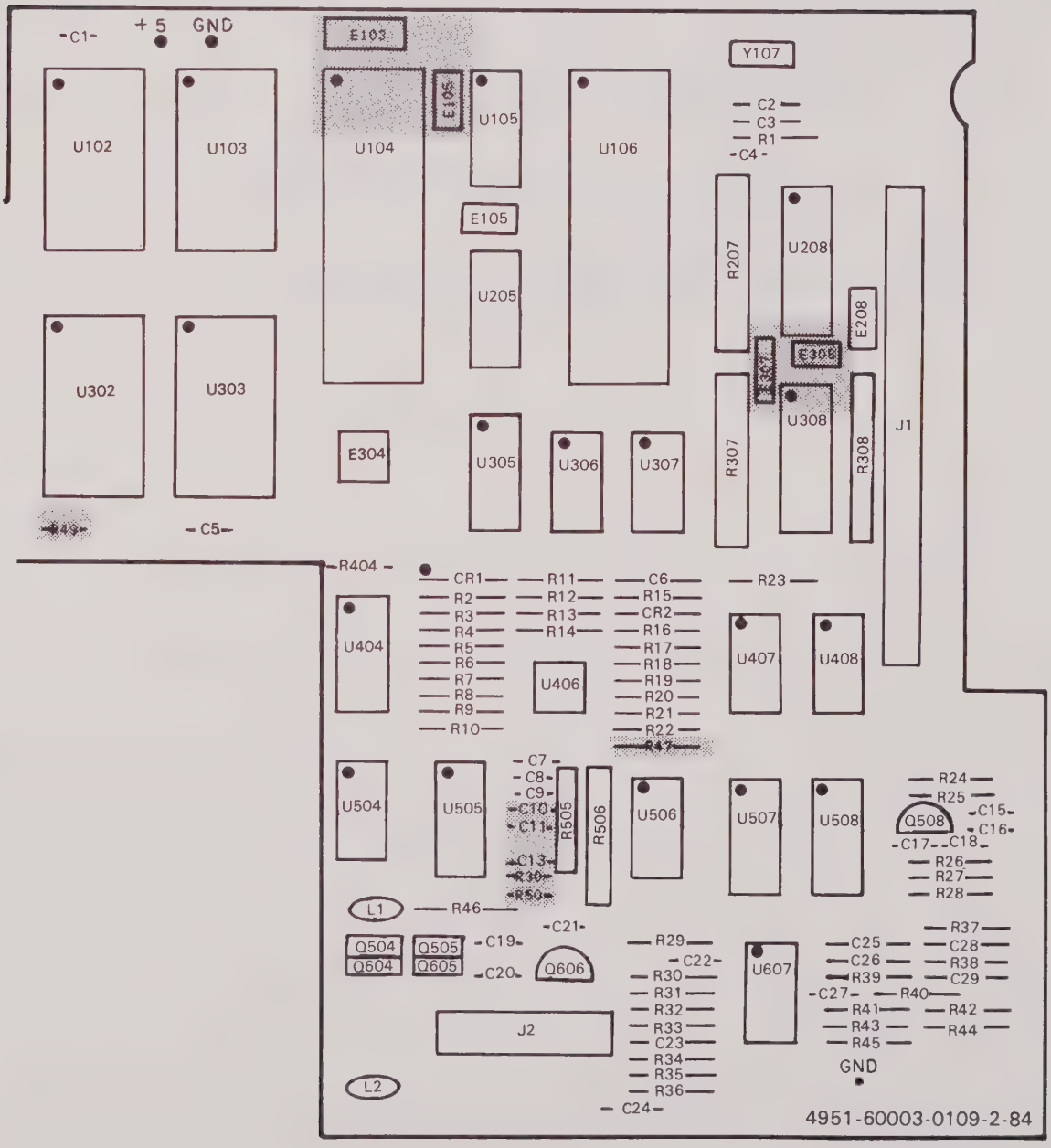
Add A3C30 0160-3879 CAPACITOR-FXD .01uF +-20% 100VDC CER, CD=7,
MFR CODE 00901, MFR P/N C320C103M1R5CA

Page 6-15, Table 6-7. Replaceable Parts (cont)

Add A3R49 0757-0442 RESISTOR 10K 1% .125W FTC=0+-100, CD=9,
MFR CODE 24546, MFR P/N C4-1/8-TO-CNF-55-1,T1

Page 8-88, Figure 8-32. A3 Tape Board Component Locator
Replace with the Component Locator shown below:

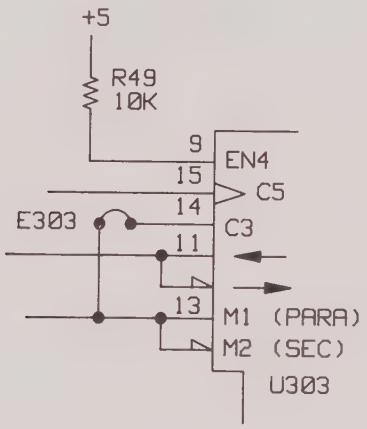
Components Added: E103, E105, R49, R47, E307, E308, R30, R50
Components Deleted: C12



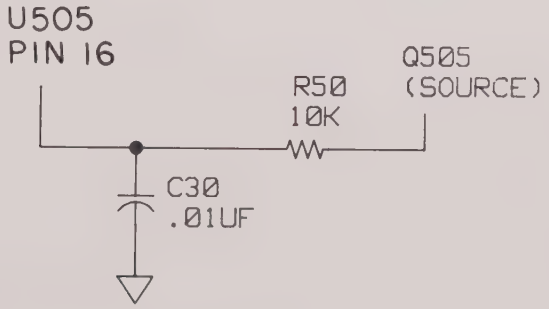
Page 8-89, Figure 8-33. A3 Tape Board CPU Schematic
Add E103 between pin 12 of U201 and pin 2 of U104.
Add E308 before the input to pin 19 of U308.
Add E307 before the input to pin 1 of U308.
Change the description of U103 to

EPROM
4096
x4K

Page 8-91, Figure 8-34. A3 State Machine Schematic
Change the control portion of U303 as shown below:



Page 8-93, Figure 8-36. A3 Read Amplifier and Speed Control Schematic (cont)
Add C30 and R50 between pin 16 of U505 and the source of Q505 as shown below:



7-8. CHANGE 3: Instruments with serial prefix 2508A or lower

Page 6-11, Table 6-7. Replaceable Parts

Delete A1R81

Add A1R82 0683-1025 Resistor 1K 1% .125W, CD=9, MFR CODE 24546, MFR P/N C4-1/8-TO-1001-F

Add A1R82 0683-1025 Resistor 1K 1% .125W, CD=9, MFR CODE 24546, MFR P/N C4-1/8-TO-1001-F

Page 6-13, Table 6-7. Replaceable Parts

Change A2U200 to 04951-10025 Programed EPROM, software rev 2.1, CD= 8
MFR CODE 28480, MFR P/N 04951-10025

Change A2U205 to 04951-10026 Programed EPROM, software rev 2.1, CD= 6
MFR CODE 28480, MFR P/N 04951-10026

N O T E

The following Signature Analysis changes are only valid with Software Rev 2.1.

If your instrument has Software Rev 2.0, please contact your Service Center, they will install Software Rev 2.1. See Service Note 4951A-11.

Page 8-44, Table 8-10. Memory Decoder Signature Analysis
Change the following signatures:

U206	14	=	0PAF

Page 8-45, Table 8-10. Memory Decoder Signature Analysis (cont)
Change the following signatures:

U207	1	=	PUAH
	2	=	6ACA
	3	=	9C81

Page 8-46, Table 8-11. Dual Port RAM Signature Analysis
Change the following signatures:

U407	11	=	5A31
	12	=	UPF8

Page 8-47, Table 8-12. CRTC RAM Signature Analysis
Change the following signatures:

U508	2	=	5A31
	4	=	UPF8
	16	=	UPF8
	18	=	5A31

Page 8-48, Table 8-12. CRTC RAM Signature Analysis (cont)
Change the following signatures:

U607	9	=	5A31
	10	=	UPF8

Page 8-51, Table 8-15. CRT Controller Signature Analysis (valid on 1.0, 2.0, and 2.1 software)
Change the following signatures:

U705	24	=	P45C

Page 8-54, CRT Controller Signature Analysis
Replace with the following table:

Table 8-16. CRT Controller Signature Analysis

LOOP:	CRT Controller	PCA: A1 Main Board
SET UP:	Wake up menu.	
SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U505 pin 2
GROUND		A1U505 pin 7
Vh = 0291		

U807	2 = 29A9		U904	2	= H499
	3 = 46UP			5	= F72U
	5 = 4F5H			6	= FSCP
	8 = P4UU			8	= P66P
	10 = P66P			9	= P4UU
	11 = F72U				

Page 8-55, Table 8-17. Deflection Signature Analysis
Change the following signature:

TP803	=	C033

Page 8-55, Table 8-18. Deflection Signature Analysis
Change the following signatures:

U803	4	=	7PA5
	5	=	001F
	6	=	4982
	11	=	U9C1
	13	=	U9C1

Page 8-56, Table 8-19. DLC Signature Analysis
Change the following signatures:

U205	1	=	U1AF
	2	=	552F
	3	=	8812
	38	=	PC3H
	39	=	6A08

Page 8-58, Table 8-21. Tic Clock Signature Analysis
Delete all of Table 8-21 (pages 8-58, 8-59)

Page 8-73, Figure 8-15. A1 Power Supply Schematic
Delete R81 (located by the Line Module on the Rear Panel)

Page 8-75, Figure 8-18. A1 CPU and DLC Schematic
Add R82 (1K) between +5V and the junction of U105 pins 6 and 4.
Add R83 (1K) between +5V and the junction of U105 pins 5 and 3.

7-9. CHANGE 4: Instruments with serial prefix 2528A or lower

Page 4-2, Table 4-1. Failure Display
Replace Table 4-1 with the following table:

Test	Failures	# of Tests
ROM 2	00	00,01 etc (counts)
ROM 8-1	00	
ROM 8-2	00	
ROM 2	00	
RAM 6	00	
RAM 8-0	00	
RAM A	00	
RAM C	00	
RAM E	00	
DLC	00	
Remote	00	
Tape	00	
RAM 8-3	00	

Page 6-13, Table 6-3. Replaceable Parts
Change A2 to 04951-60019 Memory Board Assembly CD=1,
MFR CODE 28480, MFR P/N 04951-60019

Change A2U101 to 04951-10021 MEM PROM 01, CD=0,
MFR CODE 28480, MFR P/N 04951-10021

Change A2U103 to 04951-10022 MEM PROM 02, CD=1,
MFR CODE 28480, MFR P/N 04951-10022

Change A2U200 to 04951-10023 MEM PROM 03, CD=2,
MFR CODE 28480, MFR P/N 04951-10023

Change A2U205 to 04951-10024 MEM PROM 04, CD=3,
MFR CODE 28480, MFR P/N 04951-10024

Page 6-14, Table 6-3. Replaceable Parts
Change A3 to 04951-60020 Option 001 Tape Controller Board, CD=4
MFR CODE 28480, MFR P/N 04951-60020

Page 6-15, Table 6-7. Replaceable Parts
Change A3U103 to 04951-10027 Tape PROM 404, CD=6,
MFR CODE 28480, MFR P/N 04951=10027

Add 04951-16002 ASCII Printer Tape, CD=9.
MFR CODE 28480, MFR P/N 04951-16002

Page 8-40, Table 8-8. CRTC RAM Signature Analysis

Replace only the following signatures:

U306 pin 11 = 7A70
pin 13 = 7A70

U407 pin 2 = 7A70

Page 8-43, Table 8-9. CRT Controller Signature Analysis

Replace only the following signatures:

U509 pin 24 = P4CU
pin 28 = 0C21
pin 29 = C906
pin 30 = 7U4U
pin 33 = 1993

Page 8-46, Table 8-11. Dual Port RAM Signature Analysis

Replace only the following signatures:

U407 pin 11 = 9UCU
pin 12 = C98C
pin 13 = 7CAP
pin 15 = 3F67
pin 16 = PA37

Page 8-47, Table 8-12. CRTC RAM Signature Analysis

Replace only the following signatures:

U508 pin 2 = 9UCU
pin 4 = C98C
pin 5 = A8HC
pin 6 = 7CAP
pin 8 = 3F67
pin 9 = PA37
pin 11 = PA37
pin 12 = 3F67
pin 14 = 7CAP
pin 15 = A8HC
pin 16 = C98C
pin 18 = 9UCU

Page 8-48, Table 8-12. CRTC RAM Signature Analysis

Replace only the following signatures:

U607 pin 9 = 9UCU
pin 10 = C98C
pin 11 = 7CAP
pin 13 = 3F67
pin 14 = PA37
pin 16 = A8HC

Page 8-49, Table 8-13. Dual Port RAM Signature Analysis

Replace Vh with 09P7

Replace only the following signatures:

U408 pin 5 = 075H
pin 7 = 075H
pin 9 = UH34
pin 11 = UH34
pin 12 = 990P
pin 14 = 990P

U409 pin 2 = A682
pin 4 = A682
pin 5 = 3492
pin 7 = 3492
pin 9 = 374U
pin 11 = 374U
pin 12 = F469
pin 14 = F469

U410 pin 9 = H71F

Page 8-50, Table 8-14. CRT Controller Signature Analysis

Replace Vh with 09P7

Replace only the following signatures:

U509 pin 4 = 075H
pin 5 = UH34
pin 6 = 990P
pin 7 = A682
pin 8 = 3492
pin 9 = 374U
pin 10 = F469
pin 13 = H71F
pin 35 = 65H6
pin 36 = 6536
pin 37 = A5CA
pin 38 = 507H
pin 39 = 5P92
pin 40 = 28U4

Page 8-51, Table 8-15. CRT Controller Signature Analysis

Replace only the following signatures:

U705 pin 24 = P456

Page 8-52, Table 8-15. CRT Controller Signature Analysis

Replace only the following signatures:

U710 pin 15 = HA26

Page 8-53, Table 8-15. CRT Controller Signature Analysis

Replace only the following signatures:

U906 pin 11 = 409H

Page 8-54, Table 16. CRT Controller Signature Analysis

Replace the CLOCK set up with A1U505 pin 2

Replace only the following signatures:

U807 pin 8 = P4UU
pin 10 = P66P
pin 11 = F72U

U904 pin 2 = H499
pin 5 = F72U
pin 6 = FSCP
pin 8 = P66P
pin 9 = P4UU

Page 8-55, Table 8-17. Deflection Signature Analysis

Replace Vh to 09P7

Replace only the following signatures

TP804	09P7
delete	TP803

U503 pin 2 = 28U4
pin 10 = 5P92
pin 11 = 09P7

Page 8-55, Table 8-18. Deflection Signature Analysis

Replace Vh with 0291

Replace only the following signatures:

U803 pin 4 = 7PAS
pin 5 = 001F
pin 6 = 4982
pin 11 = FP8A
pin 13 = U9C1

Page 8-56, Table 8-19. DLC Signature Analysis

Replace Vh with 6375

Replace only the following signatures:

U205 pin 1 = 092A
pin 2 = 508H
pin 3 = C86P
pin 4 = 6375
pin 5 = 6375
pin 8 = 6375
pin 15 = 6375
pin 25 = 6375
pin 33 = 03F9
pin 34 = 0375
pin 35 = 6375
pin 37 = 6375
pin 38 = 661A
pin 39 = C38A
pin 40 = 7540

Page 8-70, Table 8-29. State Machine/Bit Timer Signature Analysis:

Delete all signature analysis for U303

7-10. CHANGE 5: Instruments with serial prefix 2508A - Software Update 3.1

Software 3.1 corrects some known bugs and adds some enhancements to the HP 4951A. See Service Note 4951A-17 for complete information.

1. In Examine Data, the HP 4951A does not properly decode the call request and call accept packets.

2. In X.25 monitoring, the HP 4951A will always show the P(R) value to be 0 for any RR packet.

3. The HP 4951A will not properly excute blocks with multiple triggers "OR'd" together. This includes the lead trigger before character condition.

4. The HP 4951A gets a RECEIVER OVERRRUN indication on full duplex interfaces, when simulating or monitoring at the data rates called for by the instrument's specifications.

5. During BERT, the HP 4951A will not crrrectly raise DTR and RTS.

6. Upon completion of the BERT test, the HP 4951A does not display "OUT OF SYNC" if the received pattern looses pattern sync anytime during the test.

Order: Service Kit Part Number 04951-62619 will update the software in the HP 4951A.

Parts List

Ref Des.	HP Part No.	QTY	Description	MFR CODE	MFR NO
A2U101	04951-10021	1	MEM ROM 1	28480	04951-10021
A2U103	04951-10022	1	MEM ROM 2	28480	04951-10022
A2U200	04951-10023	1	MEM ROM 3	28480	04951-10023
A2U205	04951-10024	1	MEM ROM 4	28480	04951-10024
A3U103	04951-10027	1	TAPE ROM	28480	04951-10027

Software Installation Procedure

1. Remove the A2 and A3 boards. Follow the Disassembly/Assembly procedures in the Service Manual.

2. Remove A2U101, A2U102, A2U200, and A2U205. Replace them with the parts listed in the Parts List.

3. Locate and remove A3U103, replace it with HP 04951-10027.

4. Reassemble the HP 4951A.

5. Turn on the unit and perform the self test procedures (Section IV in the Service Manual).

N O T E

The self test pattern will display a remote failed notation.
This is because the Printer/Video board is not in the HP 4951A,
only the HP 4951B.

Rev. 3.1 software, Service Manual changes

Page 8-54, Table 16. CRT Controller Signature Analysis

Replace the CLOCK set up with A1U505 pin 2

Replace only the following signatures:

U807 pin 8 = 0205 (change Qual to +)
pin 10 = PUH9 (change Qual to +)
pin 11 = 63U5

U904 pin 2 = F7PA
pin 5 = 63U5
pin 6 = 6164
pin 8 = PUH9 (change Qual to +)
pin 9 = 0205 (change Qual to +)

Page 8-55, Table 8-18. Deflection Signature Analysis

Replace Vh with 0291

Replace only the following signatures:

U803 pin 4 = A446
pin 5 = F72U
pin 6 = H9AF
pin 11 = F5CP
pin 13 = 7U7P

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section provides information to troubleshoot and repair the HP 4951 Protocol Analyzer. Information includes Disassembly/Assembly Procedures, Theory of Operation, Troubleshooting procedures, Signature Analysis Tables, Component Locators, and Schematics.

8-2. MAINTENANCE

The HP 4951 Protocol Analyzer does not require regular cleaning or maintenance. It is recommended that the complete Performance Verification tests be performed on a regular basis.

8-3. THEORY OF OPERATION

The Theory of Operation gives a functional description of the circuits in the HP 4951.

8-4. TROUBLESHOOTING

This manual provides a two part method to isolate a problem to a particular assembly. The results of the Performance Verification Tests isolate the problem to an area of the HP 4951. Once the area is identified, complete the Signature Analysis routines to isolate the problem to a component.

8-5. RECOMMENDED TEST EQUIPMENT

Test equipment recommended to perform the troubleshooting procedures for the Protocol Analyzer is listed in Table 8-1. Equipment with equivalent characteristics may be used.

Table 8-1. Recommended Test Equipment for Troubleshooting

INSTRUMENT	CRITICAL SPECIFICATIONS	RECOMMENDED MODEL
Signature Multimeter	DC volts 250V Freq 10 MHz Resistance 10 Mohms	HP 5005A
Oscilloscope	> 20 MHz bandwidth	HP 1740A
Voltmeter	1000 VDC	HP 3466A
Function Generator	Triangle waveform, 50 KHz	HP 3310B

8-6. GENERAL HANDLING OF STATIC SENSITIVE DEVICES

The HP 4951 has many HCMOS components. Observe the following guidelines when handling static sensitive devices.

1. Wear a wrist strap which contacts the bare skin and is properly grounded.

2. All equipment, such as soldering irons, fixtures, storage containers, shelving, and so on must be grounded.

3. Work areas must be clear of non-conductive material. No plastics, polyurethane bags, coffee cups, candy wrappers, cigarette packs, or untreated trays should be near the work station.

4. Clothing should never come in contact with components or assemblies. Wear short sleeves, rolled up long sleeves, or preferably an antistatic smock.

5. Use antistatic solution on all work benches, table mats, hand tools, storage containers, chair seats, and back rests.

6. Static sensitive devices must be protected at all times. Keep the devices in their antistatic packaging.

7. All work must be performed at a static safe work station. A static safe work station has the following:

   a. Conductive table mat connected to ground through a 1 M resistor.

   b. Wrist strap grounded a through 1 M resistor.

   c. All test equipment is tied to one common ground.

8-7. DISASSEMBLY/ASSEMBLY PROCEDURES

CAUTION

Whenever internal circuits of the HP 4951 are accessed, procedures for handling static sensitive devices must be observed. For correct handling see paragraph 8-6.

Equipment Needed

#1	posidrive screwdriver
#2	posidrive screwdriver
1/4"	slotted screwdriver
1/8"	slotted screwdriver
	needle nose pliers
	static safe work area

WARNING

8000 volts can be present even when the HP 4951 is turned off.

Opening the HP 4951 case or removal of internal parts will expose live parts. Disconnect the instrument from all voltage sources before opening for any adjustments, replacements, maintenance or repair.

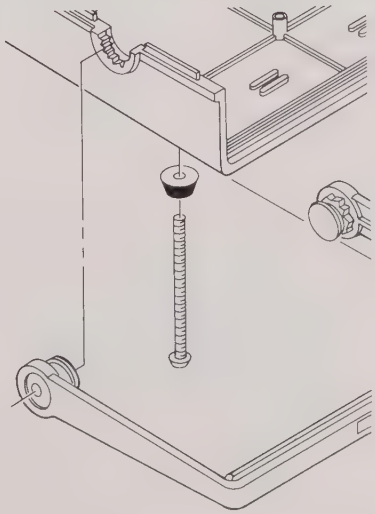
8-8. DISASSEMBLY PROCEDURES

Remove External Fastenings

Lay the instrument upside down on a flat, static protected surface.

Set the handle on the bench.

Remove the four screws which secure the feet and the case halves.

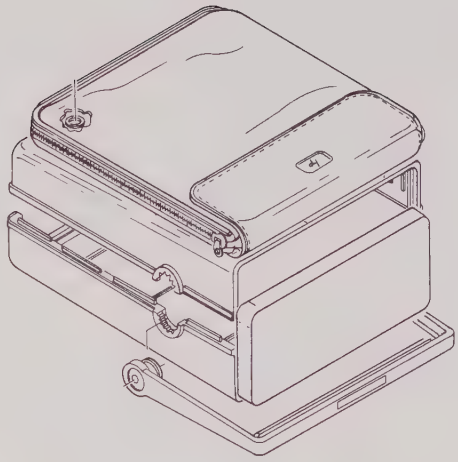


Remove The Case Top

Hold the halves of the case together and turn the instrument right side up.

CAREFULLY pull the case top up and off.

Remove the handle.



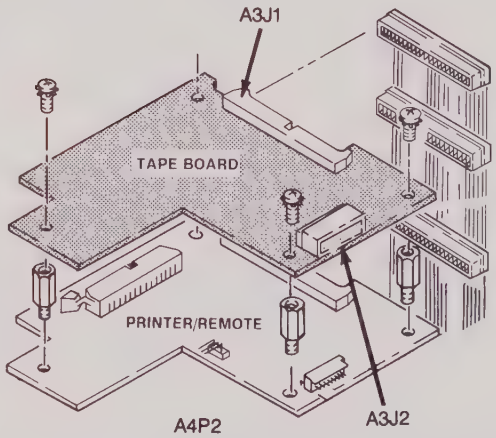
Option 001, Tape I/O Board

Disconnect A3J2, the cable between the Tape Board and the Tape Transport.

Remove the cable from A3J1.

Remove the four screws holding the Tape Board in place.

Lift the board off of the standoffs, and place the component side up on the static protected work area.



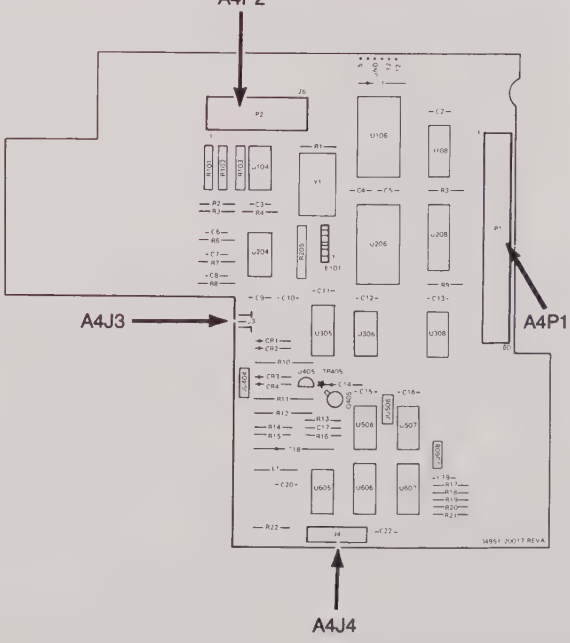
Remove the Printer/Remote Board

Remove the four threaded standoffs holding the Printer/Remote Board in place.

Disconnect the cables at A4J1 and A4P2.

Lift the board up and remove A4J4 and A4J3.

Take the board completely out of the instrument.



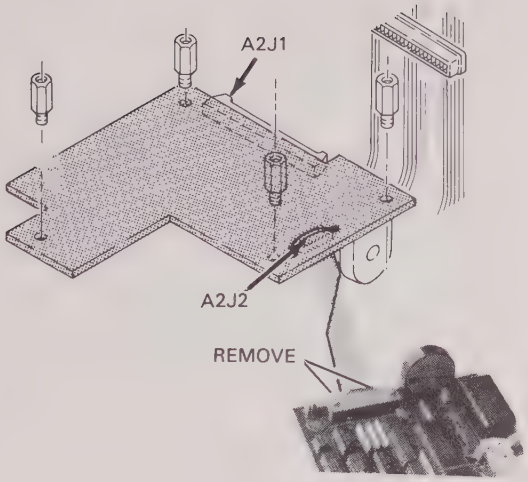
Remove the Memory Board

Remove the four threaded standoffs holding the Memory Board in place.

Lift the board up slightly and disconnect the cable at A2J1.

Fold out the Memory Board (A2J2, the cable and connector to the keyboard is tiewrapped in place).

Cut the tiewrap and remove the keyboard cable, if necessary.

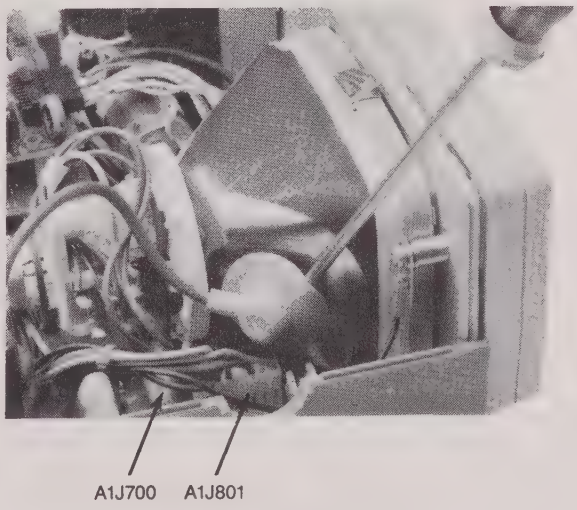


Disconnect the CRT Cables

Discharge the CRT to ground. Slide a screwdriver under the PA cable cover. Touch the metal part of the screwdriver to the sheet metal part of the front panel which is ground.

Use the needlenose pliers to squeeze together the two leads in the PA cable and remove the prongs from the CRT.

Remove the cables connected to A1J801 and A1J700.

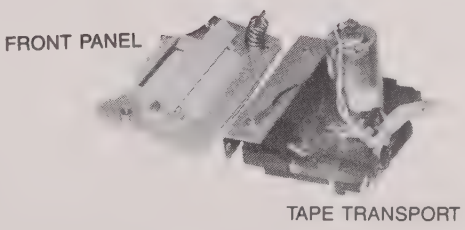


Remove the Keyboard and Front Panel

Hold the keyboard in the closed position. Lift the Front Panel and keyboard up and out of the case bottom.

Lay the Front Panel face side down on the workbench.

To remove Option 001, remove the two screws holding the Tape Transport in place and lift it off of the Front Panel.



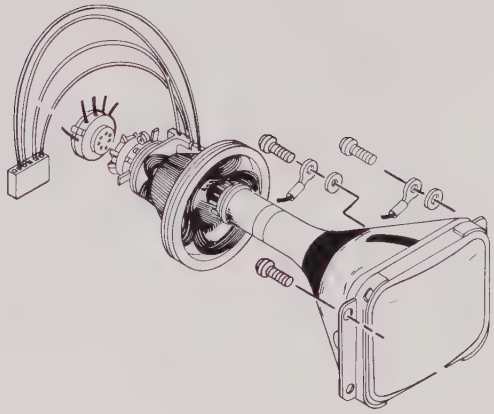
Remove the CRT

WARNING

Wear safety glasses when handling the CRT.

Disconnect the ground cables attached to the CRT.

Remove the four screws holding the CRT in place.



Remove the Keyboard Hinge Pins

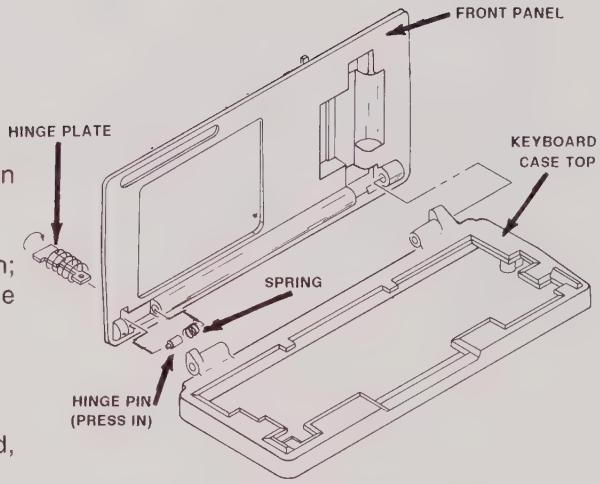
Open the keyboard.

With one hand, use the needlenose pliers to press in and turn the hinge plate.

To release the hinge pin, hold the hinge plate in; press in the other end of the hinge plate with the 1/8" screwdriver.

Pull the hinge pin out of the slot on the Front Panel.

BE CAREFUL, catch the hinge pin with your hand, there is a spring behind it.

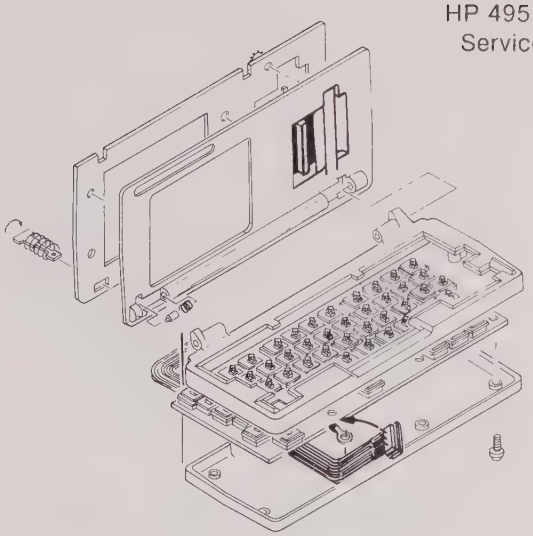


Disassemble the Front Panel and Keyboard

After the hinge plates are removed, the CRT and front panel will seperate.

Remove the eight screws from the keyboard case bottom.

Pull the keyboard case apart. The keyboard assembly and keyboard cable will be exposed.

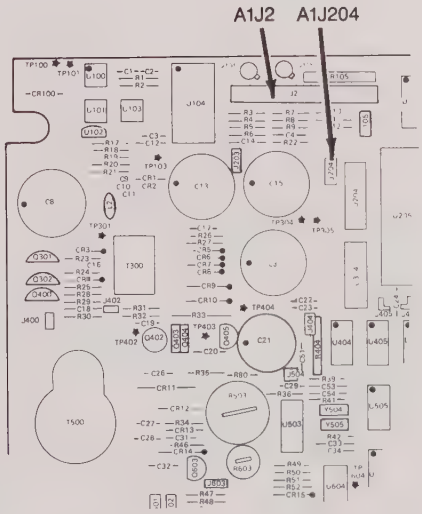


Disassemble the Back Panel

Disconnect the cables connected to A1J2 and A1J204.

Disconnect the ground cable attached to the transformer on the back panel.

Slide the Rear Panel up and out of the instrument.



8-9. ASSEMBLY PROCEDURES

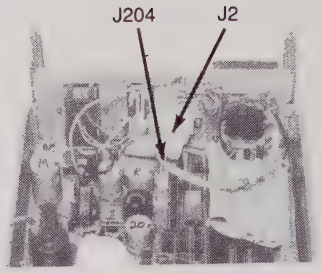
Replace A1 Main Board and Back Panel

Seat the Main Board into the case bottom.

Place the Rear Panel against the back of the case bottom.

Connect the cables to A1J2 and A1J204 and the ground wire to the transformer.

Slide the Rear Panel into place in the grooves on the back of the HP 4951 case bottom.



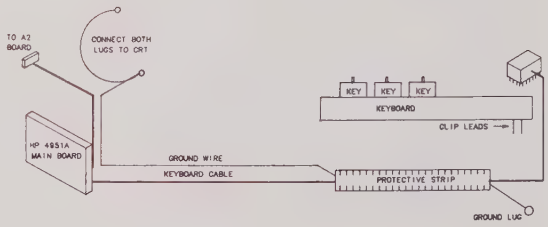
Assemble Keyboard Housing

There should be a protective strip of mylar attached to the bottom of the keyboard as well as a clear plastic strip on the cable.

The ground wire should be soldered onto the bottom of the keyboard.

Seat the keyboard printed circuit board into keyboard case bottom. Fold the keyboard cable (W6) so that it lies flat against the circuit side of the printed circuit board.

Place the keyboard into the keyboard housing. Replace the eight screws that hold the keyboard case together.



Assemble Keyboard Hinge Pins

Insert the hinge springs and pins.

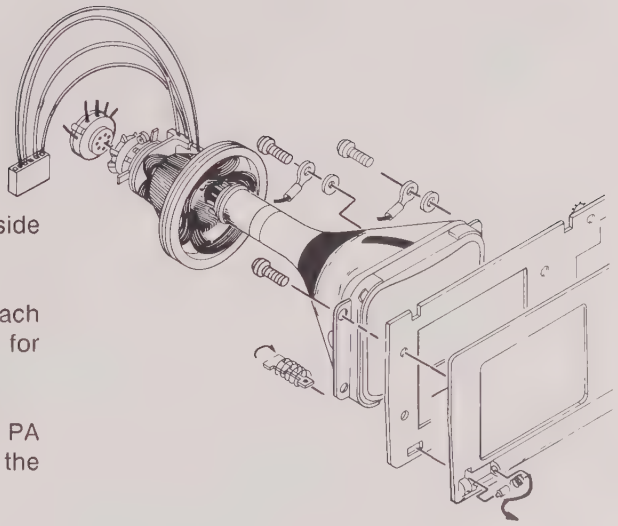
Set the hinges into the slots on the front panel.

Lock into place by wiggling the hinge plate and spring.

Mount CRT onto Front Panel

WARNING

Wear safety glasses when handling the CRT.



Place assembled front panel with the keyboard side down on the bench.

Put the standoffs in place on the CRT. Seat each standoff with the flat side aligned with the cutout for the CRT in the front panel.

Set the CRT on the standoffs with the jack for the PA LEAD to transformer A1T300 facing the side of the case. Attach the ground strap.

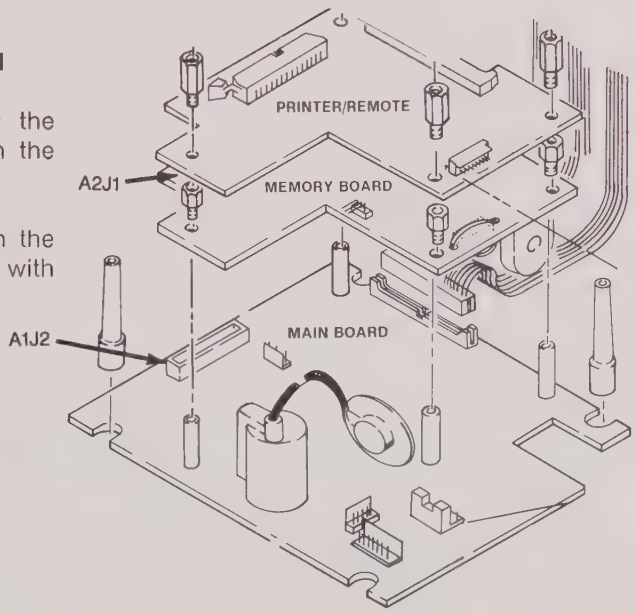
Discharge the CRT to ground (see Disassembly procedures).

Connect the Cable and Mount the Memory Board

Place the Memory Board, circuit side up by the keyboard cable. Insert the cable into A1J2 on the Memory Board. Insert and tighten the screws.

Place the Memory Board, circuit side down on the standoffs. Fasten the Memory Board into place with the threaded standoffs.

Press the cable into A2J1.



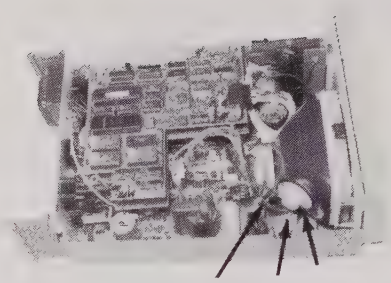
Connect the CRT Cables

Move the front panel and keyboard to the front of the case bottom.

Connect the cables from the CRT to the Main Board.

Slide the front panel into the grooves on the front of the case.

Connect the PA cable; check that both prongs are securely inside the CRT.



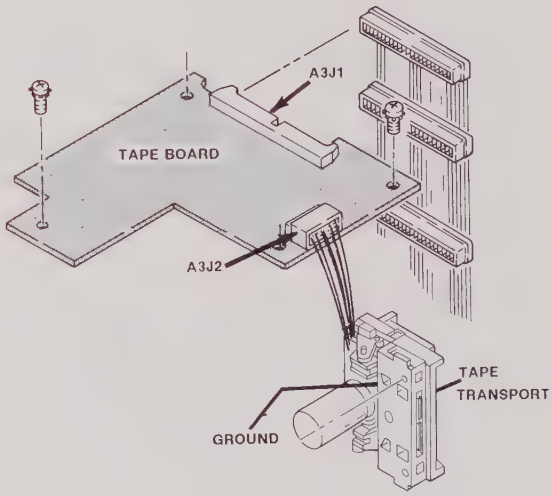
Option 001, the Tape Controller Board

Place the A3 Tape Controller Board, circuit side up on the 4 standoffs on the Memory Board.

Insert and tighten the four screws.

Attach the cable to A3J1. Press firmly into place.

Connect the cable from the Tape Transport to A3J2.



Close the Instrument

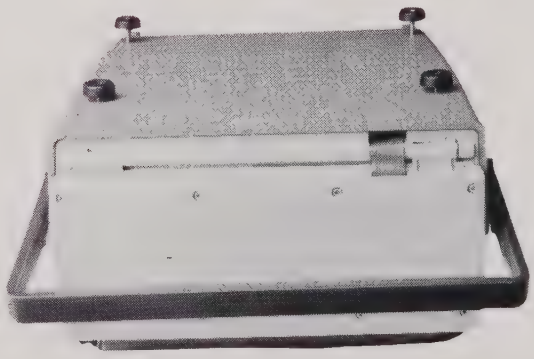
Check that the springs are installed on the handle, the large part towards the body of the handle.

Place the handle in the bottom half of the case.

Slide the case top into place. All notches and grooves must be correctly seated.

Hold the top and bottom of the instrument together and turn it upside down.

Insert the screws and rubber feet and tighten.



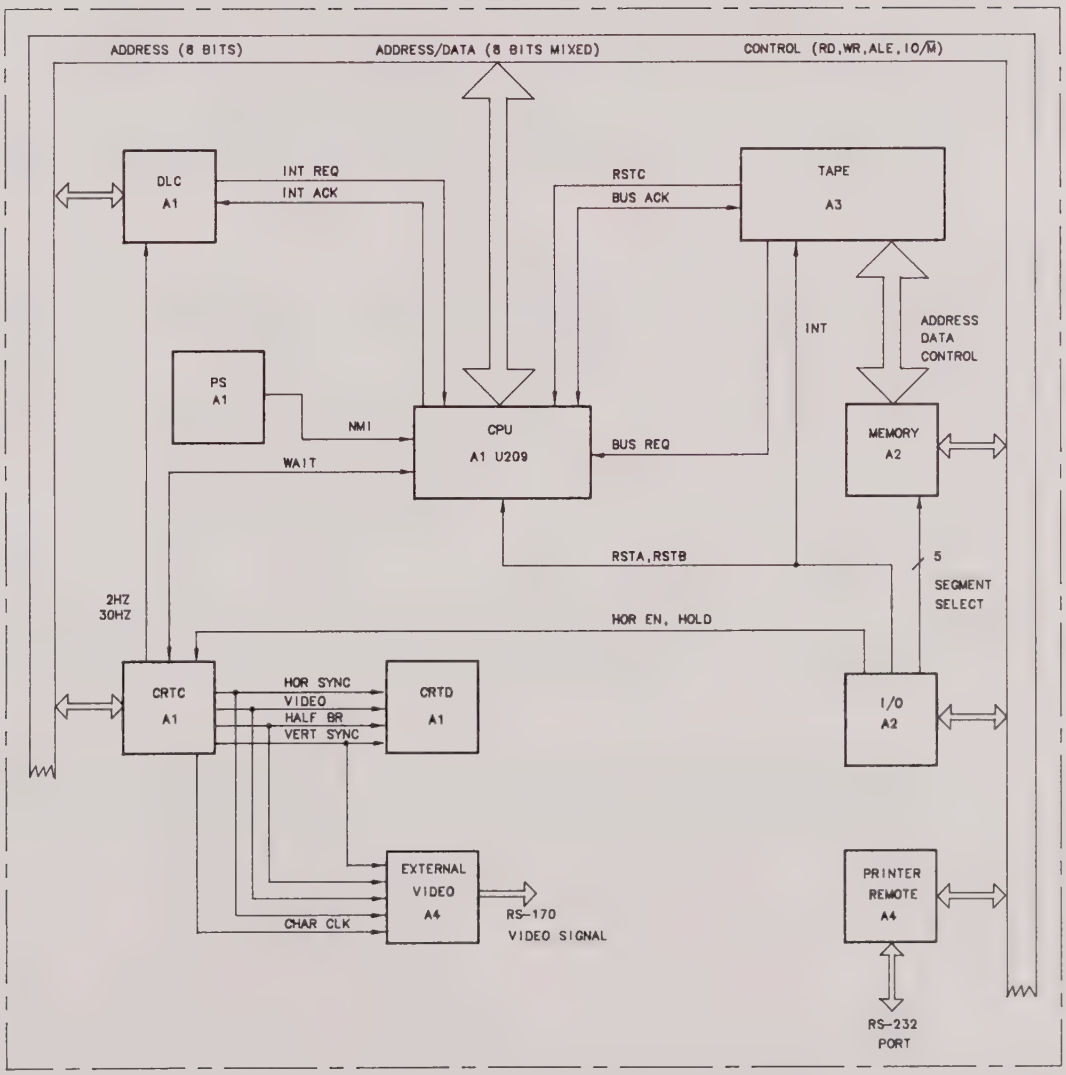


Figure 8-1. HP 4951 Overall Block Diagram

8-10. THEORY OF OPERATION

8-11. INTRODUCTION

The HP 4951 has eight functional blocks. Five of the blocks are connected by an Address/Data bus.

CPU The CPU is connected to all blocks except the CRT Deflection and Power Supply, through the Address/Data Bus. Since the CPU does not address the tape board, data must be exchanged through memory. This is called Direct Memory Access.

Tape Board The Tape Board Interface with the CPU is controlled by three signals. Bus acknowledge (BACK) and Bus Request (BREQ) are the handshaking signals for DMA and Restart C (RST C) is the tape interrupt to the CPU. The CPU sends Interrupt (INT) whenever there is data for the tape board to access in memory.

Memory Board Memory is segmented through a 64K memory space to increase the total amount of memory available to the CPU. Memory is directly addressed by both the CPU and the Tape Board. The I/O Circuitry sets the selected lines to enable the correct memory pages and segments.

I/O The I/O contains all of the CRT and DLC control lines to the CPU, Tape, Memory and CRT Controller, and Memory Segment Select lines. The keyboard Tick Clock and Beeper generates RSTA and RSTB. Horizon Enable and Hold Disable the horizontal drive circuit and memory access by the CRT. Since memory is shared, a backup RAM stores video information for the CRT. When the CPU sets the hold line the CRT cannot read the video information from memory so the CRT display is generated from the backup RAM.

CRT Controller (CRTC) The CRTC is connected to the system Address/Data Bus and is addressed as an I/O device. There are four signals which control the CRT deflection circuit: Horizsync, Video, Half BR, and Vert Sync. Two Hz and 30 Hz square waves go to the DLC circuit to generate the signal which drives the liquid crystal display.

Power Supply The HP 4951 has a switching 5 volt and +- 12 volt power supply. Control signal NMI is a non-maskable interrupt to the CPU which is active when the 5 volt rail falls below 4.75 volts. It disables RAM and the Horizontal Drive Circuit.

Data Link Control (DLC) The DLC is an I/O device controlling the I/O lines to the Interface Pod and the transfer of data between the CPU and the Interface Pod. Its primary interface is with the CPU. When an interrupt is requested and an acknowledge is received, the DLC puts an eight bit vector onto the data bus. The CPU uses the data from the vector to decide which process to perform.

Character ROM

This is information describing the type of character and is located in ROM. The character address in ROM comes from the character latch. The correct page and ROM are selected by the two most significant bits of the attribute byte. The location of the scan line for the character ROM is contained in the least significant bits of address from the CRT controller.

The eight bit output from the character ROM is shifted through a shift register to convert it from parallel to serial. The attributes are added and the signal is resynchronized and sent to the video amplifier.

Attribute Logic

Character information which contains attribute information is latched into the attribute latch. The attribute logic modifies the dot information to reflect the attributes selected. The blink frequency is 2 Hz and the cursor is 4 Hz. These frequencies are derived from counter U404 which divides the vertical sync rate. The halfbright attribute is created by the analog circuitry on the deflection circuitry. The modified dot information is resynchronized with the character information.

Resynchronization

The resynchronization circuit adds the modified dots from the attribute logic with the serial character information. DOTCLK and the CRT controller resynchronize the signal so that it enters the deflection circuitry in the right time reference.

8-22. CRT Deflection

There are three subsections of the CRT deflection circuit: vertical, video, and horizontal/high voltage.

Vertical

The vertical sync signal from the CRTC generates the vertical deflection in the CRT. The 60 Hz signal is changed to an analog signal during the duty cycle (U503) driving a dual slope integrator which creates a sawtooth wave. Amplitude and DC offset for proper vertical centering must be adjusted to obtain the proper deflection size.

Video

Video, half bright, and active pull up are the inputs to the video circuit. The decoded outputs of the video output (VO) and half-bright (HB) provide a drive signal for the full bright or half bright circuitry. The half bright or full bright voltage is applied to the cathode of the CRT.

The active pull-up (APU) is a 10-20 nanosecond pulse which provides sharp transitions between signals at the video amplifier output. APU is generated for three transitions in:

full bright to the off state,
half bright to the off state,
and full bright to half bright state.

Characters on the display smear when the APU circuit is not working correctly.

Horizontal Deflection/High Voltage

Horizontal sync (HS) and high voltage are generated from the same circuit. HS drives the flyback transformer which provides all supply voltages and horizontal deflection. Duty cycle correction makes the signal appropriate for driving the deflection circuitry.

Drive enable is controlled by NMI and Horizon. At power-up the signal is disabled. Once the HP 4951 passes Self Test and the CRT controller is programmed, HS goes high. The output from the drive enable circuit is shifted from 5 to 12 volts to drive the flyback FET which goes to the flyback transformer.

NMI

NMI is a non-maskable interrupt that overrides HS if the 5 volt rail drops below 4.75 volts. It also provides circuit protection from transcient problems.

HORIZON

When HORIZON is high, HS is input to the flyback transformer.

Flyback Transformer

The flyback transformer generates all supply voltages and provides the proper signal for horizontal deflection. It sends a video amp supply voltage of 28 volts which is routed through the active pull up and provides the post accelerator voltage of 8-9 KV. The other flyback transformer outputs provide biasing for the CRT, positive grid bias, intensity adjust, and focus adjustment.

W A R N I N G

8000 volts can be present in the HP 4951 circuitry even when it is turned off.

S-Curve Correction

The S-curve correction circuit provides a current ramp to create uniform horizontal deflection. A variable inductor changes the overall deflection width in the horizontal axis.

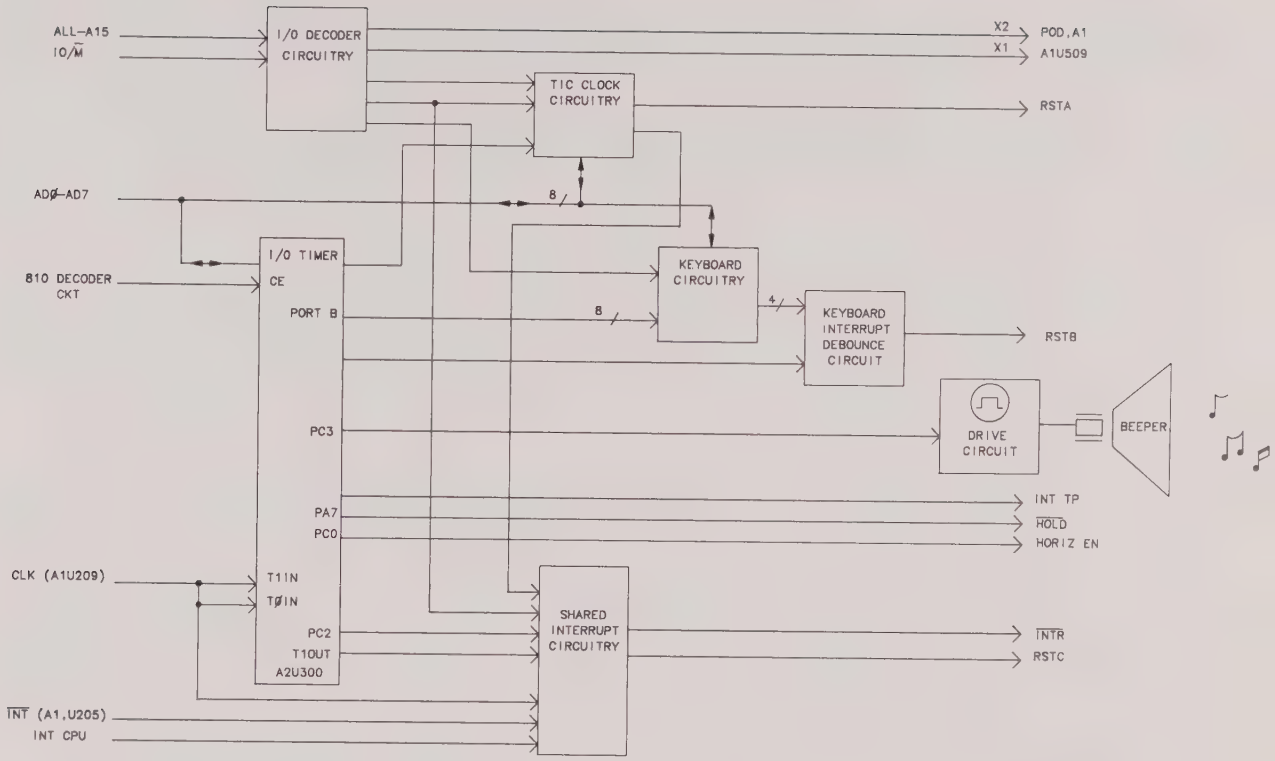


Figure 8-6. I/O Block Diagram

8-23. I/O

The I/O provides clocks and selects the I/O device for incoming and outgoing data from the HP 4951.

I/O Decoder

The I/O decoder is addressed by the CPU through control lines. It decodes the I/O device to be addressed and the operation (read/write) to be performed.

I/O Timer

The I/O timer is an NSC 810, it processes information from the CPU and generates clocks and interrupts. When the CPU sends an address on the address/data bus, the I/O timer puts out data or brings data in from the specified I/O devices.

TO OUT clocks the tick clock. T1 OUT generates an interrupt to the CPU. PC1 and PC2 clear the interrupts to the Keyboard interrupt/debounce and interrupt circuits. PC3 drives the beeper.

Tick Clock Circuitry

The tick clock is a counter which provides timing information for data coming into the HP 4951. Every time the HP 4951 makes a timing measurement, the measurement is made using tick marks.

The tick clock sends an interrupt to the CPU every 64 counts to update timing information in the capture buffer. When the CPU gets this interrupt it services the tick clock and updates the buffer. During normal operation, when information comes in, it is stored in the capture buffer and tagged with timing information.

Keyboard

The keyboard circuitry activates a keyboard scan line. When a key on the keyboard is pressed, one of the columns becomes active. There are four interrupt lines form the keyboard. The columns are read through the NSC 810 by the CPU.

Shared Interrupt Circuitry

When INT is generated by the SCC, it is synchronized to the rest of the system causing the tick clock contents to be latched in. Then the interrupt request is passed onto the CPU.

Drive Circuit

The drive circuit for the beeper is turned off or on by PC3 from the I/O timer. A 12 V squarewave activates the beeper.

8-31. I/O Timer Functions (U104)

The I/O Timer is used as an I/O Expander on the Tape Board providing an interface to the processor via the Address/Data Port. Addresses are latched in on the falling edge of the ALE signal from the processor.

Port A — PA0-PA7 is used by the shift register (U303) to do the serial-parallel conversion necessary for bit to byte conversion.

Port PB0 — This input is connected to flip flop U408 pin 5. The main processor sets it while writing to the mail box address which is used by the main processor and read by the tape processor. The tape processor is interrupted and then reads the I/O port to identify the interrupt. If the interrupt was caused by the main processor, the tape processor reads from the mail box to obtain instructions during DMA.

Port PB1 — At a logic 0, the tape is positioned over a hole or is despooled. The difference between a "hole" and "despooled" is determined by counting time (hole detect).

Port PB2 — At a logic 0, the tape cartridge is in the tape drive; at a logic 1, the tape drive is empty.

Port PB3 — A logic 0 means that the tape is write protected (WPR).

Port PB4 — A logic 0 at this output sets the interrupt flip flop (U408 Pin 4) and clears the interrupt condition created by the main processor (CLR-INT).

Port PB5 — When this output is a logic 1, the I/O Timer requests an interrupt from the processor (INT).

Port PB6 — When this output is a logic 0, it turns off the LEDS in the tape cartridge and forces the motor speed to zero (motor-OFF).

Port PB7 — Data from the tape read amplifier (RD AMP) is input to this port.

Port PC0 — Not used.

Port PC1 — Not used.

Port PC2 — A logic 0 puts the I/O Timer into a strobed mode. The read/write signal will determine the operation, the I/O Timer can strobe data in and out of a port or into and out of the shift register

The other 3 bits of port C are used by the timer functions of the I/O Timer.

Port PC3 — Is the gating signal for timer 1 and timer 0 (TG).

Port PC4 — Is the input for timer 1 (T1 IN).

Port PC5 — Is the output for timer 1 (T1 OUT).

Functions

The I/O Timer has four basic functions.

1. Timer 0 controls the tape drive motor speed (Tach Ref). This signal and the TACH signal which is fed back from the drive motor are the inputs into the Servo Loop.

2. Timer 2 counts distance moved on the tape by counting "Tach" pulses. When "Tach" pulses count equals 968, the tape has moved one inch.

3. Timer 2 detects gaps or the absence of flux reversals on the tape. The state machine resets the gap counter each time a flux reversal is detected.

4. Timer 2 counts the number of bits in a byte. The state machine uses this information to control the shift register.

8-32. Direct Memory Access (DMA)

The bus interface to the main processor is used for Direct Memory Access. When the Bus Request Line (BREQ) goes high, the tape processor requests access to the bus. Once the tape processor has control of the bus, it is forced into single step mode. It remains halted until the bus acknowledge line (BACK) is asserted and a DMA cycle can be started. Once BACK is asserted, the tape processor is released; this sets up the address and the data bus and controls the RD, WR, and ALE lines for memory transfer to the bus going to the main processor. One byte of information is transferred at a time.

The address, data, RD, WR, and ALE lines are set to a high impedance state when the tape processor does not have bus acknowledge. The processors can interrupt each other to perform an operation. When the tape processor interrupts the main processor, it programs PB4 on the I/O Timer to a logic 0 for a few microseconds. The interrupt line to the main processor is normally a logic 1. When the main processor interrupts the tape processor, it sets J2 pin 49 to a logic 0 and then to a logic 1 on the rising edge of the pulse. The interrupt flip flop (U408) is set to a logic 0, to interrupt the tape processor. The processor checks the I/O Time to determine which interrupt has been requested. The interrupt line may be activated by any one of 3 sources:

an interrupt from the main processor,
the cartridge is not loaded in the tape transport,
or the hold detect circuitry is activiated by either a hole in the tape or by a despooled tape condition.

When an interrupt occurs, the tape processor will read Port A of the I/O Time (Bits 0,1,2) to determine the source of the interrupt.

8-33. State Machine

This circuit furnishes parallel-to-serial and serial-to-parallel data conversion using a delta-distance coding scheme as per the Standard Interface Format (SIF). An eight bit, parallel-in/parallel-out shift register (U303) controlled by the state machine, is the interface between the I/O Timer and the Read/Write electronics.

Port A of the I/O Timer is used in the strobed mode to allow data to be transferred asynchronously between the I/O Timer and the shift register. During read mode, the SIO strobes data into the I/O Timer after every octet. Likewise the SIO strobes data from the I/O Timer into the shift register at the beginning of each byte recorded on the tape.

The state machine uses a programmable counter/timer to measure the time or length between flux reversals. The timer is implemented in the form of a 2K X 8 EPROM (U102) and a latch. The output is the count which is fed back to the address lines. Remaining address lines are used as load/count, read/write, present data bit and next data bit.

If read is selected, the state machine loads an initial count. The initial count prevents the counter from counting beyond 63 which will cause a flux reversal. The sixth bit of the counter is shifted into the shift register as serial data and the counter once again is preloaded.

The State Machine operates in five basic modes:

Reading tape and detecting gaps	(GO=1 and write=0)
Reading tape, synchronizing to start of records (This is the first read data state machine).	(GO=0 and write=0)
Reading tape, reading bytes from a record (This is the second read data state machine).	(GO-0 and write=0)
Writing gaps on tape.	(GO=1 and write=1)
Writing data on tape.	(GO=0 and write=1)

8-34. Motor Control Servo Loop

Analog Switch and Integrator

The velocity control of the motor tries to match the tach signal with the tach reference signal. The analog switch (U404) compares these 2 signals (in the frequency domain). The Pulse Width Modulator (U505) puts out a reference voltage of 5 volts which is then input to pin 3 of U404 and pin 6 of U406. U406 inverts the 5 volts to give a -5 volt reference which is applied to pin 6 of U404. These two reference voltages charge the RC networks C8, C11, R8, and R9. The tach reference from the I/O Timer and the tach pulses from the tape drive motor control the analog switch. If the frequencies of these two signals are equal, the output current at pin 1 of U404 is zero and the motor speed would be correct. If one of the signals driving the analog switch is pulsing faster than the other, the net charge at the output of the analog switch entering the integrator will be other than zero, generating the appropriate error signal at the output of U406 pin 1.

Pulse Width Modulator and Current Sense

The pulse width modulator (U505) monitors the motor current (pin 16) and the error voltage from the integrator circuit (pin 2) to modify the pulse to the power FETs which drive the motor.

Driver and Power MOSFETs

Driver (U504) takes the output of the pulse width modulator and converts the pulses from TTL level to 12V for a logic 1. It also monitors an input line from the processor to decide whether the motor is operating in forward or reverse mode. The MOSFETs are current limited to approximately 3 amps by the signal from the pulse width modulator to reduce the current demands on the power supply.

Motor Control

The motor control includes the signals of hole detect, tape inserted tach pulse and write protect as well as the motor speed control. The low speed (during read/write) is approximately 40 inches per second (IPS) while the high speed (Fast Forward or Rewind) is approximately 80 IPS.

Read/Write Functions

Both of the read and write electronics are multiplexed, using the same hardware for both tracks on the head. The read signal is amplified and differentiated. The differentiated signal is tested for zero crossings which corresponds to reversals in the flux direction . Reversals are only sensed when the read signal is above a minimum threshold, the delta distance format is used.

Zeros are recorded at 1600 flux reversals per inch while ones are recorded at 914 flux reversals per inch. The write circuit limits the current to the write head to approximately less than seven milliamps. The current direction (and flux) is reversed by a digital signal as each bit is recorded. Zeros are recorded at one bit per 625 E-6 inches (1600BPI) and ones are recorded at one bit per l090, E-6 inches (914 BPI).

8-35. Tape Transport/Cassette

Hole Detect

There is an infrared LED phototransistor in the transport. In each cassette, there is a mirror mounted at a 45 degree angle that reflects the infrared light to the phototransistor through the tape. At both ends of the tape, there is a series of holes which allow some light to pass through the tape onto the phototransistor, thus turning it on.

The signal from the emitter of the phototransistor is fed into a comparator (U506). If the voltage is greater than .5 volts, it is assumed there is a hole in the tape (or the tape is despooled) and the appropriate action is taken by the processor.

8-37. Troubleshooting Procedures for Specific Circuits

8-38. Turn On Instrument/Microprocessor Wakes Up

Test Failure Code

one long, continuous beep

Description

If the beep stops the microprocessor and the power supply are working.

Failure Troubleshooting

1. Perform the No Op Signature Analysis routine for the microprocessor, Table 8-7.
2. Failure possible in I/O Timer test, see paragraph 8-39 also.

8-39. I/O Timer

Test Failure Code

one long, continuous beep

Description

Tests the operation of the Dual Port RAM and the arbiter circuits.

Failure Troubleshooting

1. Perform the Signature Analysis routine for the I/O Timer, Table 8-8.
2. Failure possible in Microprocessor, see paragraph 8-38 also.

8-40. Dual Port RAM and Arbiter

Test Failure Code

no beep

Description

Tests operation of Dual Port RAM and Arbiter circuit.

Failure Troubleshooting

1. Perform the Signature Analysis routine for the Dual Port RAM, Tables 8-16 and 8-17.

2. Perform the Signature Analysis routine for the Arbiter, Tables 8-9 and 8-10.

8-41. CRT Controller

Test Failure Code

no beep
no CRT display

Description

Checks operation of the deflection circuits.

Failure Troubleshooting

1. Perform the Signature Analysis routine for the CRT Controller, Tables 8-18 through 8-22 and Table 8-12.

2. If the CRT display does not turn on, perform the Signature Analysis routine and analog troubleshooting procedures for the Deflection Circuitry, Table 8-20 and 8-21.

8-42. ROM

Test Failure Code

The ROM test is performed once at turn on. ROM failures are displayed under FAILURES by the appropriate ROM on the CRT.

Description

The microprocessor checks all ROMs (except ROM 0000) and places pass/fail information in memory. If any ROM device fails after the test sequence is performed, the Test Failure Table is displayed. Press EXIT(HALT) to access the Top Level menu.

Failure Troubleshooting

1. Perform Signature Analysis routine for the Memory Decoder, Table 8-13.

8-43. RAM

Test Failure Code

The RAM test is performed once at turn on. RAM failures are displayed under FAILURES by the appropriate RAM on the CRT.

Description

The microprocessor checks all RAM and places pass/fail information in memory. If any RAM device fails after the test sequence is performed, the Test Failure Table is displayed. Press EXIT(HALT) to access the Top Level menu.

Failure Troubleshooting

1. Perform Signature Analysis routine for the Memory Decoder, Table 8-13.

8-44. Data Link Control Circuitry (DLC)

Test Failure Code

Number of times failed displayed under FAILURES column.

Description

Microprocessor checks the DLC for proper operation.

Failure Troubleshooting

1. Perform the Signature Analysis routine for the DLC, Table 8-22.

8-45. Remote

Test Failure Code

Number of times failed is displayed under the FAILURES column or message indicating that the board is missing is displayed.

Description

Checks that the Printer/Video board is connected and functioning.

Failure Troubleshooting

1. Connect the Printer/Video board securely to the A1 cable.
2. Perform the Printer/Video troubleshooting procedure given in paragraph 8-52.

8-52. Troubleshooting the Servo Loop

There are two type of failures in the servo loop:

the tape drive motor is not rotating,
and the tape drive motor is rotating at an incorrect speed.

The Tape Drive Motor is not Rotating

1. Close all of the switches in A3E304.

2. Turn on the HP 4951. The unit is now in DMA mode for troubleshooting.

3. The motor should start turning after about 10 seconds. The CRT will have a continuous DMA mode display.

4. Follow the procedure described in Figure 8-14, the Tape Motor Not Rotating Troubleshooting Flowchart.

The Tape Drive Motor is Rotating at an Incorrect Speed

1. Close all of the switches in A3E304.

2. Turn on the HP 4951.

3. After about 10 seconds the motor should start rotating, a continuous DMA will be displayed on the CRT.

4. Use a counter to check for a 38.4 kHz (+-2%) frequency at A3U506 pin 1. Check A3U404 pin 10 for a 38.4 kHz (+-100 Hz) signal.

   correct: Proceed to step 5.

   wrong: Check A3U404 pins 3 and 6 for +-5 volts respectively. They must be equal in amplitude with opposite polarity.

5. Check A3U404 pins 4 and 5 for a 5 volt square wave with a frequency of 38.4 kHz.

6. Verify that the waveforms shown on the apron of the Read Amplifier and Speed Control Schematic appear in the circuit under test.

If the procedures in steps 1-6 DO NOT correct the motor speed problem, contact the Service Engineer at CTD (Colorado Telecommunications Division, 303-593-8700).

8-53. Troubleshooting Despooling Problems

Use the following procedures if the HP 4951B despools a tape or displays a <Despool > error message, even if it does not despool the tape.

1. Get the Top Level Menu.
   Press <Mass Store>.
   Press <Tension> to set the tension on the tape.

2. Check A3U506 for the following voltages:

IC	Pin #	Voltage	
A3U506	2	5	
	4	0	
	5	.5	
A3U506	2	low	(pull A3U504 pin 4 high, leave high for next measurements)
A3U201	6	high	
A3U306	2	low	

   Disconnect the pull up from A3U506 pin 4.

3. Insert a tape cartridge into the tape drive assembly.

   A3U201 pin 4 should be high,
   A3U201 pin 6 should be low.

4. Get the Top Level Menu.
   Press <Mass Store>.
   Put a probe on A3U201 pin 6.
   Press <Catalog>.

   There should be a pulse every time a hole is detected.

If steps 1-4 pass, perform steps 5 through 6.

5. Connect a storage scope to A3U506 pin 2 and measure the time interval of a hole while the tape is cataloging.

   SCOPE SET UP

sweep speed	.5 msec
volts/div	2

   TAPE CATALOG PROCEDURE

   Get the Top Level Menu.
   Press <Mass Store>.
   Press <Catalog>.

6. The correct measurement is 1.8 msec. If the time is too long, try another tape cassette.

   a. If a new tape cassette does not give the correct reading, first change A3U506. Repeat the test procedure in step 5.

   b. If changing A3U506 does not correct the problem, change the Tape drive assembly and repeat the test procedure in step 5.

If the procedures in steps 1-6 DO NOT correct the tape despool problem, contact the Service Engineer at CTD (Colorado Telecommunications Division, 303-593-8700).

8-54. Troubleshoot the DLC Circuit

The procedure assures that the Interface Pod is working correctly.

1. Connect pod to HP 4951.

2. Input the DCE program for the Interface Pod being used, the programs are given in the appropriate appendix for each Interface Pod.

3. Jumper pod as directed in Service Manual.

4. Run the program.

5. Fold out the memory board and disconnect the key board cable. DO NOT turn the HP 4951 off.

6. Use the following tables to determine the failed component on the A1 board. Run the DCE program while checking for the states given in the tables.

U106

Pin #	18173A	18174A	18179A
1	T	T	T
3	T	T	T
4	T	H	T
6	T	H	T
8	T	T	T
10	T	T	T
12	T	H	T
13	T	T	T

U204

Pin #	18173A	18174A	18179A
2	L	L	L
5	L	H	L
6	L	L	L
9	H	H	H
11	L	L	L
12	L	L	L
15	L	L	L
19	T	T	T

U205

Pin #	18173A	18174A	18179A
5	T	T	T
12	T	T	T
13	T	H	T
14	T	T	T
15	T	T	T
16	T	T	T
17	T	T	T
18	T	T	T
19	T	T	T
21	T	H	T
24	T	T	T
25	T*	T	T
26	T	T	T
27	T	T	T
28	T	T	T
29	L	L	L

U304

Pin #	18173A	18174A	18179A
1	T	T	T
11	T	T	T

T = TOGGLING
H = LOGIC HIGH
L = LOGIC LOW

* = 3.5 volts

8-55. Remote/Printer Circuit Troubleshooting

Quick Test Procedure

1. Get the Top Level Menu on the HP 4951.

   The frequency at pin 3 of A17U206 should be 76.8 KHz.

Passes	see step 3 "passes"
Fails	proceed to step 2

2. Put the HP 4951 into the continuous self test loop.

   The frequency at pin 3 of A17U206 changes.

Passes	the problem is in the ACIA, multiplexer (A17U206, A17U306) or output stage
Fails	the problem is in the baud rate generator circuit of the Printer/Remote Board (A17U208, A17U106, or A17U108).

3. Pin 6 of A17U206 and jumper A17E101 should have a pulsing waveforms.

Passes	troubleshoot the output stages
Fails	troubleshoot A17U206 and A17U305.

8-56. Detailed Troubleshooting Procedure

If the Interface Board passes self test, but the printer does not work, the output stages are probably defective. To troubleshoot the Printer/Remote Board, use the following procedures.

1. Get the Top Level Menu.

   The following conditions must be present at A17U106:

pin 22	high.
pin 23	low.
pin 10	high.

2. Check the divide by 16 capability of the divider. The frequencies listed below should be present at A17U106:

pin 2	76.8	KHz
pin 3	38.4	KHz
pin 4	19.2	KHz
pin 5	9.6	KHz
pin 6	3.2	KHz
pin 7	4.8	KHz
pin 8	2.4	KHz
pin 9	1.2	KHz
pin 20	1843.2	KHz
pin 21	1843.2	KHz

3. Verify the divide by 64 function.

Set Up

Pull A17U208 pin 1 to 5 volts.
Pull A17U106 pins 22 and 23 to 5 volts.

Verification

Verify the following frequencies on A17U106.

pin 2	307.2	kHz
pin 3	153.6	kHz
pin 4	76.8	kHz
pin 5	38.4	kHz
pin 6	12.8	kHz
pin 7	19.2	kHz
pin 8	9.6	kHz
pin 9	4.8	kHz

4. Remove all jumpers.

5. Verify the operation of A17U108.

Set Up

Disable A17U208 by pulling pin 1 to 5 volts.

Pull pin 23 and 24 of A17U106 to 5 volts.

Verification

Connect the jumpers on A17U108 in the sequences listed below.

Verify that the correct frequency is at pin 5.

9	10	11	Frequency at pin 5	
L	L	L	12.8	kHz
L	L	H	4.8	kHz
L	H	L	9.6	kHz
L	H	H	19.2	kHz
H	L	L	38.4	kHz
H	L	H	76.8	kHz
H	H	L	153.6	kHz
H	H	H	307.2	kHz

8-57. ACIA, Multiplexers, and Output

1. Get the Top Level Menu.

   A17U206, pins 3 and 4 should have a square wave with a frequency of 76.8 kHz.

2. Put the HP 4951 into the continuous loop self test.

   Press MORE
   Select SELF TEST
   f6 (unlabeled softkey right next to MORE)

3. Verify that the following conditions exist on A17U206.

pin	2	high until self test starts, then shows negative pulses
pin	5	low until self test starts, then shows positive pulses (set the sweep rate to 1 sec on the scope)
pin	6	high until self test starts, then shows negative pulses
pin	7	high
pin	8	high
pin	9	high until self test starts, then shows negative pulses (set the sweep rate to 5 msec on the scope)
pin	10	pulses
pin	11	pulses
pin	13	negative pulses
pin	14	activity
pins	15	
	-22	activity
pin	23	low until self test starts, then shows positive pulses (set the sweep rate to 1 sec on the scope)
pin	24	low until self test starts, then shows positive pulses (set the sweep rate to 1 sec on the scope)

4. Troubleshoot the output stage.

   Set Up

   Pull pin 1 of A17U208 high (disable).

   Remove all jumpers from A17E101 through A17E106.

   Get the Top Level Menu.

   Verification

   Verify the following approximate voltage levels:

A17U204		**A17U104**	
pin 5	2 volts	pin 5	4 volts
pin 10	2 volts	pin 7	4 volts
pin 12	2 volts	pin 9	4 volts

5. Troubleshoot A17U306 and A17U204.

Set Up

Pull pins 9 and 12 of A17U306 low.

Set up the external Signal Generator to a 1 kHz sinewave at 5 volts.

Connect the Signal Generator to pins 10 and 13 of A17U306, to check TXD and RTS levels.

Verification of A17U204 Inputs/Outputs

pin	6	5 volts
pin	7	+- 12 volts
pin	8	+- 12 volts
pin	9	5 volts

6. Test the DTR output.

Set Up

Install all jumpers

A17U208 should NOT be disabled.

Put the HP 4951 into Self Test Continuous Loop.

Verification

A17U204 pin 14 should wiggle at +-12 volts

7. Troubleshoot the input stages of RXD, CTS, and DCD.

Set Up

Remove jumpers A17E103, A17E105 and A17E106.

Input a sinewave of 12 volts p-p at 1 kHz.

Verification

Check for the following voltages at the outputs of A 17U104

pin	1	5 volts
pin	2	5 volts
pin	14	5 volts

8-58. EXTERNAL VIDEO CIRCUIT TROUBLESHOOTING

1. The frequency at A17U502 pin 3 should be 15.84 KHz.

Passes	troubleshoot A17U605, A17Q405, and associated circuitry
Fails	troubleshoot A17U606 A17U506, and associated circuitry

2. Frequencies for normal operation in the COUNTER CKTS:

A17U506

pin	1	633.6	kHz
pin	2	15.84	kHz
pin	4	17.28	kHz
pin	5	900	Hz
pin	6	360	Hz
pin	10	180	Hz
pin	12	15.84	kHz
pin	13	360	Hz

A17U507

pin	1	180	Hz
pin	2	900	Hz
pin	3	180	Hz
pin	4	180	Hz
pin	5	15.66	kHz
pin	6	15.84	kHz
pin	8	60	Hz
pin	9	60	Hz
pin	10	120	Hz
pin	11	15.66	kHz
pin	12	60	Hz
pin	13	17.8	Hz

A17U605

pin	3	15.84 kHz
pin	5	15.84 kHz
pin	11	633.6 kHz
pin	13	633.6 kHz

A17U606

pin	1	633.6	kHz
pin	4	15.84	kHz
pin	6	15.84	kHz
pin	8	60	Hz
pin	9	60	Hz
pin	10	60	Hz
pin	14	15.84	kHz
pin	15	15.84	kHz

A17U607

pin	1	60	Hz
pin	2	15.84	kHz
pin	7	60	Hz
pin	10	60	Hz
pin	11	60	Hz
pin	12	120	Hz

NOTE

Frequencies may vary slightly.

3. Troubleshoot A17U507, A17U606, and A17U607.

Set Up

Remove Jumper A17JU608.

Pull pin 10 of A17U607 to 5 volts.

Verification

Verify that the following frequencies are present:

A17U507				A17U606				A17U607			
pin	1	180	Hz	pin	8	60	Hz	pin	1	60	Hz
pin	2	900	Hz	pin	9	60	Hz	pin	2	15.84	kHz
pin	3	180	Hz	pin	10	60	Hz	pin	11	60	Hz
pin	4	180	Hz					pin	12	120	Hz
pin	5	15.66	kHz								
pin	6	15.84	kHz								
pin	8	60	Hz								
pin	9	60	Hz								
pin	10	120	Hz								
pin	11	15.66	kHz								
pin	12	60	Hz								

Replace jumper A1JU608

4. Troubleshoot A17U506 and A17U606.

Set Up

Check that the voltage at A17TP405 is -5 volts.

Verification

Check the frequencies given for A17U506 and A17U606 in step 4.

Check the output stage waveform, they should match the waveform shown on the apron of the schematic.

8-59. FINAL TEST PROCEDURE

After performing a repair on an HP 4951 please complete the following final test procedure. This test turns lines on and off as well as stimulates various triggers. Any protocol may be used but be aware that HDLC was selected for this procedure.

N O T E

Complete the proper set up when using a different protocol.

Two HP 4951s must be used for this test. Use the same set up for both HP 4951s. The HP 4951 that was repaired is the Unit under test and the other one is the standard or control unit. After performing the test procedure, reverse the roles of the HP 4951s and perform the test again to verify that all operations are functions correctly. Operate the unit under test in the monitor line mode.

Set Up

Protocol	HDLC
Ext Adrr	OFF
Ext Ctrl	OFF
Code	ASCII 8
DTE Clock	DCE
Bits/Sec	19200
Disp Line	2 LINE

Procedure

Enter the following program for the standard or control HP 4951.

Table 8-5. Program for the Control Unit

Simulate	DCE
Block 1	
Set lead	CTS ON
and then	
Send	THIS IS A FINAL TEST
and then	
Start timer	1
and then	
Increment counter	1
and then	
Wait	100
and then	
Stop timer	1
and then	
Set lead	CTS OFF

Table 8-5. Control or Standard HP 4951 Program (continued)

Block 2

Set lead	DSR ON
and then	
Send	SO FAR I'M GOOD
and then	
Start timer	2
and then	
Increment counter	2
and then	
Wait	200
and then	
Stop timer	2
and then	
Set lead	DSR OFF

Block 3

Set lead	CD ON
and then	
Send	TEST COMPLETE AND I PASSED!
and then	
Start timer	3
and then	
Increment counter	3
and then	
Wait	300
and then	
Stop timer	3
and then	
Set lead	CD OFF
If counter	3 > 3
then goto block	5

Block 4

Goto block	1

Block 5

Goto block 1 or	STOP TEST

NOTE

Block 5 can cause the test to run continuous or stop the test after 3 passes.

Set up

Use the same set up described in the beginning of paragraph 8-56.

Procedure

Enter the following monitor program for the unit to be tested

Table 8-6. Program for the Unit Under Test

Block 1

When lead	CTS GOES ON
Then goto block	2

Block 2

Start timer	1
and then	
Increment counter	1
When lead	CTS GOES OFF
Then goto block	3

Block 3

Stop timer	1
When lead	DSR GOES ON
Then goto block	4

Block 4

Start timer	2
and then	
Increment counter	2
When lead	DSR GOES OFF
Then goto block	5

Block 5

Stop timer	2
When lead	CD GOES ON
Then goto block	6

Block 6

Start timer	3
and then	
Increment counter	3
When lead	CD GOES OFF
Then goto block	7

Table 8-6. Program for the Unit Under Test (continued)

Block 7	
If counter	3 > 3
Then goto block	9
Block 8	
Goto block	1
Block 9	
Goto block 1 or	STOP TESTS

NOTE

Block 9 can cause the test to run continuous or stop the test after 3 passes.

Test Procedure

1. Press <Exam Data>.
2. The appropriate messages from the programs should appear on the CRT.
3. Press <Timer> and <Cntr>.

   Compare the numbers for the standard and the unit under test, they should be the same.

8-60. SIGNATURE ANALYSIS

The following tables provide signatures for troubleshoooting the digital portion of the HP 4951. Before performing a signature analysis routine, check the set up for that Signature Table.

8-61. SIGNATURE ANALYSIS TABLES

Table 8-7. Microprocessor No Op Signatures

LOOP: Microprocessor No Ops PCA: A1 Main Board
SET UP: Remove A1J108, move A1J809 to T, and on PC board, open A2E101 and A2E102. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U209 pin 8 (A15)
CLOCK	-	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = 0001 (+5 V)

U209
1 = HC89 (A8)
2 = 2H70 (A9)
3 = HPP0 (A10)
4 = 1293 (A11)
5 = HAP7 (A12)
6 = 3C96 (A13)
7 = 3827 (A14)
8 = 755P (A15)
12 = UUUU (D0)
13 = 5555 (D1)
14 = CCCC (D2)
15 = 7F7F (D3)
16 = 5H21 (D4)
17 = 0AFA (D5)
18 = UPFH (D6)
19 = 52F8 (D7)

A2U101 pin 20 = 6H49

NOTE: Replace A1J108, A1J809, A2E101 and A2E102 at end of test

Table 8-8. I/O Timer Signature Analysis

LOOP:	I/O Timer	PCA: A2 Memory Board
SET UP:	Connect A1U304 pin 3 to ground. Disconnect the Inter Pod. (To disable beeper, place a jumper from ground on the A2 board to A2R207, end nearest board edge).	
SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
CLOCK	+	A2TP4
GROUND		A2TP1(GND)
Vh = A803 (+5 V)		

U300 2 =	45C5	31 = 45766
4 =	0000 (low)	32 = U576
5 =	0000 (low)	33 = 6574
6 =	A803 (high)	34 = 228F
7 =	0000	35 = AF58
8 =	0000	36 = UUP5
10 =	A803	37 = 6783
11 =	45C5	38 = 16PP
12 =	2F56	39 = H22C
13 =	90AA	
14 =	A9UU	
15 =	3F27	
16 =	73HH	
17 =	CU86	
18 =	35HC	
19 =	P3PP	
21 =	F1PF	
22 =	7769	
23 =	15H9	
24 =	H5HC	
25 =	95H1	
26 =	8A31	
27 =	C163	
28 =	UU94	
29 =	U07C	
30 =	HHHA	

Table 8-9. Arbiter Signature Analysis

LOOP: Arbiter PCA: A1 Main Board

SET UP: Connect A1J406 and A1J405 to T on PC board the turn on condition. To disable beeper, place a jumper from ground on the A2 board to A2R207 end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U605 pin 12
CLOCK	+	A1U605 pin 2
GROUND		A1U605 pin 8

Vh = 00UP

U306	1 =	00U1
	2 =	00F2
	3 =	00F1
	4 =	00U1
	12 =	00U1
U405	2 =	00U1
	3 =	0033
	5 =	003F
	6 =	00F2
	8 =	000U
	9 =	00U1
	11 =	00UP
	12 =	00U1
U406	2 =	003F
	3 =	00FH
	5 =	000U
	9 =	00UP (high)
	11 =	00FH
	12 =	00UP (high)
U505	10 =	00FH
	11 =	0033
	12 =	00UP
	13 =	0000

Table 8-9. Arbiter Signature Analysis (continued)

LOOP: Arbiter PCA: A1 Main Board

SET UP: Jumper A1J406 and A1J405 to T on the PC board, the turn on condition. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U605 pin 12
CLOCK	+	A1U605 pin 2
GROUND		A1U605 pin 8

Vh = 00UP

U506 1 = 00U1
2 = 0055
3 = 00UP (high)
4 = 000U
5 = 00F2
6 = 00UH
12 = 00PP
13 = 0033

U605 12 = 00U1
13 = 0033
14 = 0055

U606 1 = 00UP (high)
2 = 000U
3 = 00U1
4 = 00F1
5 = 0000 (low)
6 = 00UP (high)

After test return A1J406 and A1J405 to normal positions.

Table 8-10. Arbiter Signature Analysis

LOOP:	Arbiter	PCA: A1 Main Board
SET UP:	A1J108 open, set A1J809 to T. Pull down A1R54 (the leg nearest the edge of the PC board). Remove jumpers A2E101 and A2E102. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).	
SIGNATURE	NORM	
START/STOP	+	A1U308 pin 18
CLOCK	-	A1U209 pin 32
GROUND		A1U209 pin 20
Vh = CC34		

U308	2 =	96PF
	3 =	96PF
	4 =	725C
	5 =	725C
	6 =	P5PH
	7 =	P5PH
	8 =	5CP0
	9 =	5CP0
	11 =	0000
	12 =	7P25
	13 =	7P25
	14 =	85PA
	15 =	85PA
	16 =	77F7
	17 =	77F7
	18 =	H58A
	19 =	H58A

After the test replace jumpers A1J108, AlJ809, A2E101 and A2E102.

Table 8-11. CRTC RAM Signature Analysis A

LOOP: CRT RAM PCA: A1 Main Board

SET UP: A1J108 open, set A1J809 to T. Connect ground to A1R54 (the leg nearest the edge of the PC board). Remove jumpers A2E101 and A2E102. To disable the beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U410 pin 13
CLOCK	+	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = 826P

U306
4 = 826P (high)
5 = 826P (high)
6 = 826P (high)
11 = U81P
12 = 826P (high)
13 = U81P

U407
2 = U81P
3 = C25F
4 = 7C47
5 = 3319
6 = 8P3U
7 = C133
8 = A206
9 = 2A1F
10 = 7P25
21 = HP66
22 = 826P (high)
23 = U81P
24 = 19H6
25 = 5H21
26 = 826P (high)
27 = 826P (high)

Table 8-11. CRTC RAM Signature Analysis (continued)

LOOP: Arbiter Multiplexers PCA: A1 Main Board

SET UP: A1J108 open, set A1J809 to T. Connect ground to A1R54 (the leg nearest the edge of the PC board). Remove jumpers A2E101 and A2E201. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U410 pin 13
CLOCK	+	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = 826P

U408
1 = 826P (high)
3 = 7P25
4 = 7P25
6 = 2A1F
7 = 2A1F
9 = A206
10 = A206
12 = C133
13 = C133
15 = 0000 (low)

U409
1 = 826P (high)
3 = 8P3U
4 = 8P3U
6 = 3319
7 = 3319
9 = 7C47
10 = 7C47
12 = C25F
13 = C25F
15 = 0000 (low)

Table 8-11. CRTC RAM Signature Analysis (continued)

LOOP: Arbiter Multiplexers PCA: A1 Main Board

SET UP: A1J108 open, set A1J809 to T. Connect ground A1R54 (the leg nearest the edge of thePC arest the edge of the PC board). Remove jumpers A2E101 and A2E102. To disablebeeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U410 pin 13
CLOCK	+	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = 826P

U410 1 = 826P (high)
3 = 5H21
4 = 5H21
6 = 19H6
7 = 19H6
9 = HP66
10 = HP66
12 = U81P
13 = U81P
15 = 0000 (low)

U606 5 = 0000 (low)
6 = 826P (high)
8 = 0000 (low)
9 = 826P (high)
10 = 826P (high)
11 = 826P (high)
13 = 0000 (low)

U804 12 = 0000 (low)
13 = 826P (high)

After the test replace jumpers to normal position.

Table 8-12. CRT Controller Signature Analysis

LOOP:	CRT Controller	PCA: A1 Main Board
SET UP:	Connect A1U304 pin 4 to ground. A1U509 Pin 21 (CCLK) frequency = 633.66 kHz +-100 Hz. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).	
SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
CLOCK	+	A1U509 pin 23
GROUND		A1U509 pin 1
Vh = 4106 (+5 V)		

U509 22 = UUCU
24 = P4CU
25 = 0P8A
26 = HF17
27 = 2U99
28 = OC21
29 = C906
30 = 7U4U
31 = C840
32 = 21F5
33 = 1993

Table 8-13. Memory Decoder Signature Analysis

LOOP:	Memory Decoder	PCA: A2 Memory Board
SET UP:	Connect A1U304 pin 7 to ground. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).	
SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
CLOCK	+	TP300
Vh = U973		

U101 20 = 1F34

U103 20 = FH93

U104 20 = CAH9

U105 20 = 22CF

U200 20 = 26H0

U201 20 = 4PA6

U202 20 = 4818

U203 20 = 81F4

U204 20 = 0187

U205 20 = C6U3

U206
- 1 = C0C1
- 2 = 63P7
- 3 = 6C5C
- 4 = 1F34 ROM enable
- 5 = 8P39
- 6 = U973 (high)
- 7 = 22CF RAM enable
- 11 = CAH9 RAM enable
- 12 = FH93 ROM enable
- 14 = OPAF
- 15 = 8P39

Table 8-13. Memory Decoder Signature Analysis (continued)

LOOP:	Memory Decoder	PCA: A2 Memory Board
SET UP:	Connect A1U304 pin 7 to ground. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).	
SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
CLOCK	+	TP300
Vh = U973		

U207
1 = PUAH
2 = 1UC0
3 = P696
5 = 26H0 ROM enable
6 = C6U3 ROM enable
7 = 7U8P
9 = 4PA6 ROM enable
10 = 4818 RAM enable
11 = 81F4 RAM enable
12 = 0187 RAM enable
13 = 6C5C
14 = 63P7
15 = 7U8P

U302
1 = 07P6
2 = C1FF
3 = 63P7
4 = 6C5C
5 = 16HP
6 = A66U
12 = P936

U303
9 = 16HP
10 = PUAH

U403
1 = 2864
2 = P936
3 = OP75
4 = 16HP
5 = A66U
6 = COC1
11 = PUAH
12 = PUAH
13 = A66U

Table 8-14. Dual Port RAM Signature Analysis

LOOP: Dual Port RAM PCA: A1 Main Board

SET UP: Normal operation, wake up menu. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U509 pin 21
GROUND		A1U509 pin 1

Vh = 80F6

U407	2 =	0000 (low)
	3 =	UHF2
	4 =	9FF9
	5 =	AF72
	6 =	HPF5
	7 =	4FF0
	8 =	7UF1
	9 =	8042
	10 =	0000
	11 =	9UCU
	12 =	C98C
	13 =	7CAP
	15 =	3F67
	16 =	PA37
	17 =	2336
	18 =	A8HC
	19 =	63P2
	22 =	0000 (low)
	23 =	0000 (low)
	24 =	62C4
	25 =	1799
	26 =	80F6 (high)
	27 =	80F6 (high)

Table 8-15. CRTC RAM Signature Analysis

LOOP:	CRTC RAM		PCA: A1 Main Board
SET UP:	Normal operation, wake up menu. To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).		
SIGNATURE		QUAL	
	START/STOP	+	A1U509 pin 40
	QUAL	-	A1U509 pin 13
	CLOCK	+	A1U509 pin 21
	GROUND		A1U509 PIN 1
Vh = 80F6			

U508	1 =	0000 (low)
	2 =	9UCU
	3 =	63P2
	4 =	C98C
	5 =	A8HC
	6 =	7CAP
	7 =	2336
	8 =	3F67
	9 =	PA37
	11 =	PA37
	12 =	3F67
	13 =	2336
	14 =	7CAP
	15 =	A8HC
	16 =	C98C
	17 =	63P2
	18 =	9UCU
	19 =	0000 (low)

Table 8-15. CRTC RAM Signature Analysis (continued)

LOOP: CRTC RAM PCA: A1 Main Board
SET UP: Normal operation, wake up menu. To disable beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U509 pin 21
GROUND		A1U509 PIN 1

Vh = 80F6

U607 1 = UHF2
2 = 9FF9
3 = AF72
4 = HPF5
5 = 4FF0
6 = 7UF1
7 = 8042
8 = 0000
9 = 9UCU
10 = C98C
11 = 7CAP
13 = 3F67
14 = PA37
15 = 2336
16 = A8HC
17 = 63P2
19 = 0000
20 = 80F6 (high)
21 = 0000
22 = 62C4
23 = 1799

U610 11 = 0000
12 = 80F6 (high)
13 = 80F6

U708 12 = 80F6 (high)
13 = 0000 (low)

Table 8-16. Dual Port RAM Signature Analysis

LOOP:	Dual Port RAM		PCA: A1 Main Board
SET UP:	Normal operation, wake up menu. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).		
SIGNATURE		NORM	
	START/STOP	+	A1U509 pin 40
	CLOCK	+	A1U509 pin 21
Vh = 09P7			

U408	1 =	0000 (low)
	2 =	0000
	4 =	0000
	5 =	075H
	7 =	075H
	9 =	UH34
	11 =	UH34
	12 =	990P
	14 =	990P
U409	1 =	0000 (low)
	2 =	A682
	4 =	A682
	5 =	3492
	7 =	3492
	9 =	374U
	11 =	374U
	12 =	F469
	14 =	F469
U410	1 =	0000 (low)
	2 =	2F0C
	4 =	2F0C
	5 =	P049
	7 =	P049
	9 =	H71F
	11 =	106H
	12 =	0000 (low)
	14 =	0000 (low)

8-62. Set up procedure using Self Test.

1. Turn on HP 4951.
2. Press MORE.
3. Select <SELF TEST>.
4. Select <CRT TSTS>.
5. Selct <CHAR SET 2> using Self Test.

8-63. Set up procedure using Self Test

1. Turn on HP 4951.
2. Press MORE.
3. Select <SELF TEST>.
4. Select <CRT TSTS>.
5. Select <TEST PTRN>.

Table 8-17. CRT Controller Signature Analysis (continued)

	LOOP:	CRT Controller	PCA: A1 Main Board
	SET UP:	Follow procedure in paragraph 8-62.	
SIGNATURE		NORM	
	START/STOP	+	A1U509 pin 40
	CLOCK	+	A1U509 pin 21
	GROUND		A1U509 pin 1
	Vh = 90P7		
U509	4 = 075H (MA0)		
	5 = UH34 (MA1)		
	6 = 990P (MA2)		
	7 = A682 (MA3)		
	8 = 3492 (MA4)		
	9 = 374U (MA5)		
	10 = F469 (MA6)		
	11 = 2F0C (MA7)		
	12 = P049 (MA8)		
	13 = H71F (MA9)		
	14 = 0000 (MA10) (low)		
	18 = 04F5 (DE)		
	35 = 65H6 (CR3)		
	36 = 6536 (R2)		
	37 = A5CA (R1)		
	38 = 507H (R0)		
	39 = 5P92 (HS)		
	40 = 28U4 (VS)		

Table 8-18. CRT Controller Signature Analysis

LOOP:	CRT Controller	PCA: A1 Main Board
SET UP:	Follow procedure in paragraph 8-63.	
SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	+	A1U509 pin 18
CLOCK	-	A1U509 pin 21
GROUND		A1U509 pin 1
Vh = 879F		

U705	2 = 0000
	3 = 7P95
	4 = 22PU
	5 = 024C
	6 = 09UH
	7 = 2288
	8 = 3U4F
	9 = A569
	10 = CC4F
	11 = AC40
	12 = 281H
	13 = FC12
	15 = 3F22
	16 = 6PC1
	17 = AA93
	18 = 85PF
	19 = H421
	21 = AH21
	22 = 0000 (low)
	23 = FPP6
	24 = P45C

Table 8-18. CRT Controller Signature Analysis (continued)

LOOP:	CRT Controller	PCA: A1 Main Board
SET UP:	Follow procedure in paragraph 8-63.	
SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	+	A1U509 pin 18
CLOCK	-	A1U509 pin 21
GROUND		A1U509 pin 1
Vh = 879F		

U709
2 = 09UH
3 = C556
4 = 54F7
5 = 024C
6 = 22PU
7 = HP89
8 = A713
9 = 7P95
11 = 879F
12 = 6627
13 = 1857
14 = 76U1
15 = P45C
16 = AH21
17 = 0000
18 = 879F
19 = FPP6

U710
2 = UO57
3 = C556
4 = 54F7
5 = 2234
6 = 1UFP
7 = HP89
8 = A713
9 = 34U4
11 = 0000
12 = 0F2C
13 = 1857
14 = 76U1
15 = HA2C
17 = 0000
18 = 879F

Table 8-18. CRT Controller Signature Analysis (continued)

LOOP:	CRT Controller	PCA: A1 Main Board
SET UP:	Follow procedure in paragraph 8-63.	
SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	+	AlU509 pin 18
CLOCK	-	A1U509 pin 21
GROUND		A1U509 pin 1
Vh = 879F		

U806 2 = AC40
3 = 281H
4 = FC12
5 = 3F22
7 = 879F
10 = 6PC1
11 = AA93
12 = 85PF
13 = H421
14 = H421
15 = 0000

U905 1 = IFC0
2 = 2288
3 = 3U4F
4 = A569
5 = 3FH0
9 = CC4F
13 = 3FH0

U906 1 = U057
2 = IFC0
3 = 7F4H
4 = 2234
5 = A738
6 = 9U81
9 = IUFP
11 = 409H (change NORM to -)
13 = A524

U907 1 = 2288
2 = 3U4F
3 = A738
4 = 7F4H
5 = 9U81
6 = 6450
9 = 6450

Table 8-19. CRT Controller Signature Analysis

LOOP: CRT Controller		PCA: A1 Main Board
SET UP: Wake up menu.		
SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U505 pin 2
GROUND		A1U505 pin 7
Vh = 0291		

U807	2 = 29A9
	3 = 46UP
	5 = 4F5H
	8 = H9AF
	10 = HC3H
	11 = F72U
U904	2 = H499
	5 = F72U
	6 = F5CP
	8 = HC3H
	9 = H9AF

Table 8-20. Deflection Signature Analysis

LOOP:	Deflection	PCA: A1 Main Board
SET UP:	Normal operation, wake up menu.	
SIGNATURE	NORM	
START/STOP	+	A1U509 pin 40
CLOCK	+	A1U509 pin 21
GROUND		A1U509 pin 1
Vh = 09P7		

TP804 = 09P7 (PU) (high)
TP803 = 0816

U503 2 = 28U4
10 = 5P92
11 = 09P7 (high)

Table 8-21. Deflection Signature Analysis

LOOP:	Deflection	PCA: A1 Main Board
SET UP:	Normal operation, wake up menu.	
SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U904 pin 3
GROUND		A1U904 pin 7
VH = 0291		

U803 4 = A446
5 = F72U
6 = H9AF
11 = F5CP
13 = 0000 (LOW)

Table 8-22. DLC Signature Analysis

LOOP:	DLC	PCA A1 Main Board
SET UP:	Pull A1U304 pins 3 and 4 low. Beeper should beep once.	
SIGNATURE	QUAL	
START/STOP	+	A2U401 pin 2
QUAL	-	A1U205 pin 32 (D/C)
CLOCK	-	A1U205 pin 36 (RD)
GROUND		A1U205 pin 31
Vh = 6375		

U205	1 =092A
	2 = 508H
	3 = C86P
	4 = 6375
	5 = 6375 (high)
	8 = 6375 (high)
	15 = 6375 (high)
	19 = 0000 (low)
	25 = 6375 (high)
	33 = 03F9
	34 = 03F9
	35 = 6375
	37 = 6375
	38 = 661A
	39 = C38A
	40 = 7540

8-64. A2 Memory Board Troubleshooting

Table 8-23. Tic Clock Signature Analysis

LOOP: Tic Clock		PCA: A2 Memory Board
SET UP: Wake up menu.		
SIGNATURE	NORM	
START/STOP	+	A2U404 pin 9
CLOCK	-	TP300
Vh = 48CF		
U404 1 = 0A3C		
3 = 513C		
4 = CH89		
5 = 745P		
6 = 8PA4		
10 = 7103		
11 = C2A1		

Table 8-24. Tic Clock Signature Analysis

LOOP: Tic Clock Signature Analysis PCA: A2 Memory Board
SET UP: Wake up menu.

SIGNATURE	NORM	
START/STOP	+	A2U404 pin 9
CLOCK	-	A2TP3
GROUND		A2TP1

VH = H6PH

U302
1 = 998C
2 = 998C
3 = H622
4 = 9944
5 = 0000
6 = 4UA9
11 = 998C
12 = H622
13 = H6PH (high)

U303
1 = H6PH
3 = 0000
4 = 3AHH
6 = PF30
11 = H6PH
12 = 998C
13 = 0000

U403
8 = H6PH (high)
9 = H6PH
10 = 998C

U503
2 = H6PH (high)
3 = 0000
4 = H6PH
5 = H6PH (high)
6 = 0000 (low)
9 = H6PH (high)
10 = 0000 (low)
11 = 0000 (low)
13 = H6PH (high)

FOR U503 ONLY:

START/STOP	+	U503 PIN 9
CLOCK	-	U300 PIN 10

Table 8-25. Tic Clock Signature Analysis

LOOP: RST B PCA: A2 Memory Board
SET UP: Pull A1U304 pin 3 low. To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
CLOCK	+	A2TP4
GROUND		A2TP1

Vh = A803

U402
2 = 0000 (low)
3 = 45C5
5 = 0000 (low)
6 = A803 (high)
9 = A803 (high)
10 = 16PP
11 = 0000 (low)
13 = A803 (high)

U500
1 = O4P8
2 = UUP5
3 = AF58
4 = 228F
5 = HHHA
10 = A803 (high)
13 = 0000 (low)

8-65. SIGNATURE ANALYSIS FOR OPTION 001, TAPE BOARD

Before performing any Signature Analysis on the A3 Tape Controller Board, read the A3E304 switch position and A3E208 function descriptions.

NOTE: Make sure there is no tape in tape drive assembly.

A3E304

Switch 1 closed = external ROM open = 8048 internal ROM

Switch 2 closed = normal open = no ops

Switch 3 closed = run motor at 40 ips open = normal

Switch 4 closed = run motor at 40 ips open = normal

A3E208

A \ system bus acknowledge
B /
B \ stand alone bus acknowledge
C /

A3E105

A \ 27C32 4K EPROM
B /
B \ 27C16 2K EPROM
C /

Normal settings of switch A3E304

Switch	Setting
1	closed
2	closed
3	open
4	open

Jumper A3E208 A-B

Table 8-26. Microprocessor No Ops

LOOP: Microprocessor No Op PCA: A3 Tape Controller
SET UP: Wake up menu. S304 switch 1 closed and 2, 3, and 4 open.

SIGNATURE	NORM	
START/STOP	+	A3U106 pin 23
CLOCK	-	A3U106 pin 11
GROUND		A3U106 pin 20

Vh = 7A70

U105
2 = AF5U
3 = H62U
4 = C21A
5 = 1P45
6 = HA07
7 = AA4C
9 = 0000
10 = 2U1H
11 = HOAA
12 = 3750
13 = P030
14 = 4442
15 = 6569

U106
1 = 7A70
3 = 0000
4 = 7A70 (high)
5 = 7A70 (high)
6 = 0000 (low)
7 = 7A70 (high)
12 = H62U
13 = C21A
14 = HA07
15 = H0AA
16 = P030
17 = 4442
18 = 4U2A
19 = 0772
21 = 9635
22 = 1734
23 = U424
24 = 0000

Table 8-26. Microprocessor No Ops (continued)

LOOP: Microprocessor No Ops PCA: A3 Tape Controller
SET UP: Wake up menu. Switch 1 of A3E304 is closed and 2, 3 and 4 are open.

SIGNATURE	NORM	
START/STOP	+	A3U106 pin 23
CLOCK	-	A3U106 pin 11
GROUND		A3U106 pin 20

Vh = 7A70

U205
2 = P0HH
3 = 4U2A
4 = 0772
5 = F4U1
6 = 9635
7 = 8F52
9 = 0000
10 = 4FH2
11 = 1734
12 = UA12
13 = U424
14 = 0000
15 = 0000 (low)

Table 8-27. I/O Timer Signature Analysis

LOOP:	I/O Timer	PCA: A3 Tape Controller
SET UP:	Switch A3E304 set switch 3 open and 1, 2, and 4 closed.	
NOTE:	Use ground indicated below, otherwise signatures will be unstable.	
SIGNATURE	NORM	
START/STOP	+/-	A3U104 pin 10
CLOCK	-	A3U104 pin 3
GROUND		A3U104 pin 20
Vh = 99FA		

U104	4 = 0000 (low)
	7 = 7347
	8 = 99FA (high)
	11 = 0H45
	12 = 7466
	13 = 0425
	14 = 7ACF
	15 = P72U
	16 = 7487
	17 = P0PU
	18 = 9031
	19 = 7347
	21 = P672
	22 = 7UC8
	23 = P672
	24 = 7UC8
	25 = P672
	26 = 7UC8
	27 = P672
	28 = 7UC8
	36 = 99FA

Table 8-28. State Machine/Bit Timer Signature Analysis

LOOP:	State Machine/Bit Timer	PCA: A3 Tape Controller
SET UP:	Close switches 1, 2, and 3 of A3E304, open switch 4.	
SIGNATURE	QUAL	
START/STOP	-/+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1
GROUND		A3U106 pin 20
Vh = 2016		
U305 4 = 2016		
5 = 1HF7		
6 = 2016 (high)		
7 = 2016 (high)		
9 = 0000		
10 = 0000		
11 = 0000		

Table 8-29. State Machine/Bit Timer Signature Analysis

LOOP: State Machine/Bit Timer (RD) PCA: A3 Controller
SET UP: Close switches 1, 2, and 3 of A3E304, open switch 4.
Pull U300 pins 1 and 16 to +5V.

SIGNATURE	QUAL	
START/STOP	+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1
GROUND		A3U106 pin 20

Vh = F013

U104 1 = 0000
2 = 7UP2
6 = F013 (high)
9 = F013 (high)
21 = 46C5
22 = 7C4U
23 = 6AUH
24 = 8UPP
25 = HHCF
26 = 8U8H
27 = P402
28 = CUPP
39 = F013

U301 2 = 0000 (low)
5 = 0000
6 = 4UP6
9 = 0000
12 = CUU1
15 = 3004
16 = CUU1
19 = F013

Table 8-29. State Machine/Bit Timer Signature Analysis (continued)

LOOP: State Machine/Bit Timer (RD) PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 3 of A3E304, open switch 4.
Pull U300 pins I and 16 to +5V.

SIGNATURE	QUAL	
START/STOP	+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1
GROUND		A3U106 pin 20

Vh = F013

U302
1 = F013
2 = CUU1
3 = 3004
4 = F013 (high)
5 = 0000
8 = CUU1
9 = 0000 (low)
10 = CUU1
11 = 3004
13 = CUU1
14 = 7UP2
15 = 8UU5
16 = 7UP2
17 = F013

U303
1 = CUPP
2 = P402
11 = F013 (high)
13 = 0000
15 = 0000 (low)
16 = 46C5
17 = 7C4U
18 = 6AUH
19 = 8UPP
20 = HHCF
21 = 8U8H
22 = P402
23 = CUPP

Table 8-30. State Machine/Bit Timer Signature Analysis

LOOP: State Machine/Bit Timer PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 3 of A3E304, open switch 4.

SIGNATURE	QUAL	
START/STOP	+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1
GROUND		A3U106 pin 20

Vh = 2016

U102
1 = 1HF7
2 = 2648
3 = 7CCU
4 = 7P18
5 = 4C19
6 = C8PF
8 = 88HP
9 = 7187
10 = 611P
11 = 71H9
13 = 9632
14 = UF31
15 = U77P
16 = 2FAC
19 = 2016 (high)
23 = 985H

U300
2 = 88HP
3 = 7187
4 = 611P
5 = 308U
6 = C8PF
7 = 71H9
8 = 9632
9 = 4C19
12 = 7P18
13 = UF31
14 = U77P
15 = 7CCU
16 = 2648
17 = 2FAC
18 = 1476 (CHANGE CLK TO -)
19 = 98H5

Table 8-31. State Machine/Bit Timer Signature Analysis

LOOP: Shift Register (WR) PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 4 of A3E304, open switch 3. Pull U300 pins 1 and 16 to +5V.

SIGNATURE	QUAL	
START/STOP	+	A3U302 pin 8
QUAL	-	A3U302 pin 5
CLOCK	+	A3U104 pin 3
GROUND		A3U104 pin 20

Vh = A310

U301 2 = 9340
5 = 9U0P
6 = 0000 (low)
9 = 0000 (low)
12 = 7UH7
15 = 4H16
16 = POH9
19 = 3F1P

U302 1 = 3F1P
2 = P0H9
3 = 4H16
4 = 0000 (low)
7 = F4UP
9 = 2681
10 = 3P1H
11 = 0000 (low)
13 = 0000 (low)
14 = 1A9U
15 = 9A2F
16 = 2482
17 = 9H0H

APPENDIX A

GUIDE TO INTERPRETING ANSI

A-1. INTRODUCTION

The Institute of Electrical and Electronics Engineers (IEEE) is developing ANSI symbol notation. The symbols used in this manual's schematics are designed according to IEEE Draft 91PR79-16 N. Some basic elements are similar to conventional symbology, inputs on the left and outputs on the right. Where conventional symbology gives a signal mnemonic, ANSI describes the functional behavior of the logic circuit, and the signal's relationship to the other signals. The interpretation of this effort in our schematics is to describe the truth table of each component using the ANSI symbology. Figure A-1 describes the basic notation and Table A-1 gives symbol definitions.

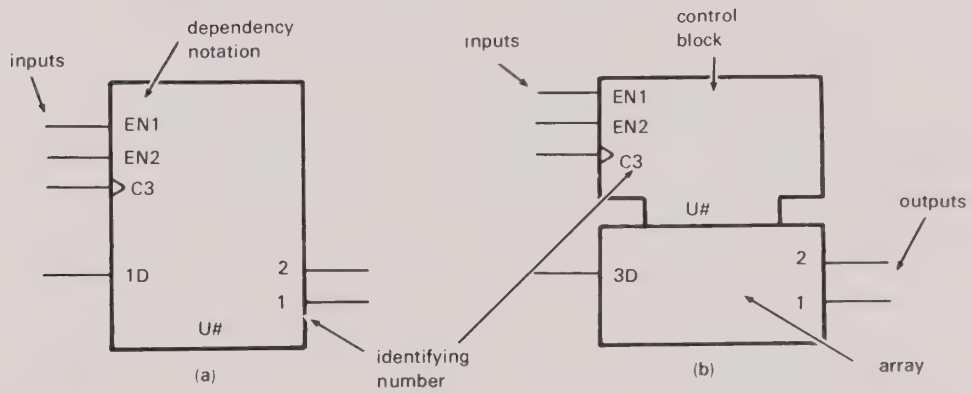


Table A-1. General Qualifying Symbols

Table A-1. General Qualifying Symbols (cont)

Symbol	
&	And gate or function.
≥1	OR gate or function. The symbol was chosen to indicate that at least one active input is needed to activate the output.
=1	Exclusive OR. One and only one input must be active to activate the output.
=	Logic identity. All inputs must stand at same state.
2k	An even number of inputs must be active.
2k+1	An odd number of inputs must be active.
1	The one input must be active.
▷ or ◁	A buffer or element with more than usual output capability (symbol is oriented in the direction of signal flow).
⎍	Schmitt trigger; element with hysteresis.
X/Y	Coder, code converter (DEC/BCD, BIN/OUT, BIN/7-SEG, etc.).
MUX	Multiplexer/data selector.
DMUX or DX	Demultiplexer.
Σ	Adder.
P−Q	Subtracter.
CPG	Look-ahead carry generator.
π	Multiplier.
COMP	Magnitude comparator.
ALU	Arithmetic logic unit.
⎍	Retriggerable monostable.
1 ⎍	Non-retriggerable monostable (one-shot).
G ⎍	Astable element. Showing waveform is optional.
!G ⎍	Synchronously starting astable.
G! ⎍	Astable element that stops with a completed pulse.
SRGm	Shift register. m = number of bits.
CTRm	Counter. m = number of bits; cycle length = 2m.
CTR DIVm	Counter with cycle length = m.
ROM	Read-only memory.
RAM	Random-access read/write memory.
FIFO	First-in, first-out memory.

*Not all of the general qualifying symbols have been used in this manual but they are included here for the sake of completeness.

Table A-1. General Qualifying Symbols (cont)

Symbol	
¬|	Postponed output (of a pulse-triggered flip-flop). The output changes when input initiating change (e.g., a C input) returns to its initial external state or level.
| ⊓	Bi-threshold input (input with hysteresis).
◇|	NPN open-collector or similar output that can supply a relatively low-impedance L level when not turned off. Requires external pull-up. Capable of positive-logic wired-AND connection.
◈|	Passive-pull-up output is similar to NPN open-collector output but is supplemented with a built-in passive pull-up.
◇|	NPN pen-emitter or similar output that can supply a relatively low-impedance H level when not turned off. Requires external pull-down. Capable of positive-logic wired-OR connection.
◈|	Passive-pull-down output is similar to NPN open-emitter output but is supplemented with a built-in passive pull-down.
▽|	3-state output.
|	Enable input When at its internal 1-state, all outputs are enabled. When at its internal 0-state, open-collector and open-emitter outputs are off. Three-state outputs are at normally defined internal logic states and at external high-impedance state, and all other outputs (e.g., totem poles) are at the internal 0-state.
	Usual meanings associated with flip-flops (e.g., R = reset, T = toggle)
|D	Data input to a storage element equivalent to:
|→ m |← m	Shift right (left) inputs, m = 1, 2, 3 etc. If m = 1, it is usually not shown.
|+m |−m	Counting up (down) inputs, m = 1, 2, 3 etc. If m = 1, it is usually not shown.
	Binary grouping. m is highest power of 2.
| CT = 15	The contents-setting input, when active, causes the content of a register to take on the indicated value.
CT = 9 |	The content output is active if the content of the register is as indicated.
	Input line grouping. . . indicates two or more terminals used to implement a single logic input.
	e.g., The paired expander inputs of SN7450.
"1" |	Fixed-state output always stands at its internal 1 state.

Table A-1. General Qualifying Symbols (cont)

Symbol	
	Logic negation at input. External 0 produces internal 1.
	Logic negation at output. Internal 1 produces external 0.
	Active-low input. Equivalent to in positive logic.
	Active-low output. Equivalent to in positive logic.
	Active-low input in the case of right-to-left signal flow.
	Active-low output in the case of right-to-left signal flow.
	Signal flow from right to left. If not otherwise indicated, signal flow is from left to right.
	Bidirectional signal flow.
	Dynamic inputs active on indicated transition POSITIVE LOGIC: 1→0; not used; 0→1 NEGATIVE LOGIC: 0→1; not used; 1→0 POLARITY INDICATION: not used; H→L; L→H
	Nonlogic connection. A label inside the symbol will usually define the nature of this pin.
	Input for analog signals.
	Internal connection. 1 state on left produces 1 state on right.
	Negated internal connection. 1 state on left produces 0 state on right.
	Dynamic internal connection. Transition from 0 to 1 on left produces transitory 1 state on right.
	Internal input (virtual input). It always stands at its internal 1 state unless affected by an overriding dependency relationship.
	Internal output (virtual output). Its effect on an internal input to which it is connected is indicated by dependency notation.

The internal connections between logic elements abutted together may be indicated by the symbols shown. Each logic connection may be shown by the presence of qualifying symbols at one or both sides of the common line and if confusion can arise about the numbers of connections, use can be made of one of the internal connection symbols.

The internal (virtual) input is an input originating somewhere else in the circuit and is not connected directly to a terminal. The internal (virtual) output is likewise not connected directly to a terminal.

APPENDIX B

HP 18173A

RS-232C/V.24 INTERFACE POD

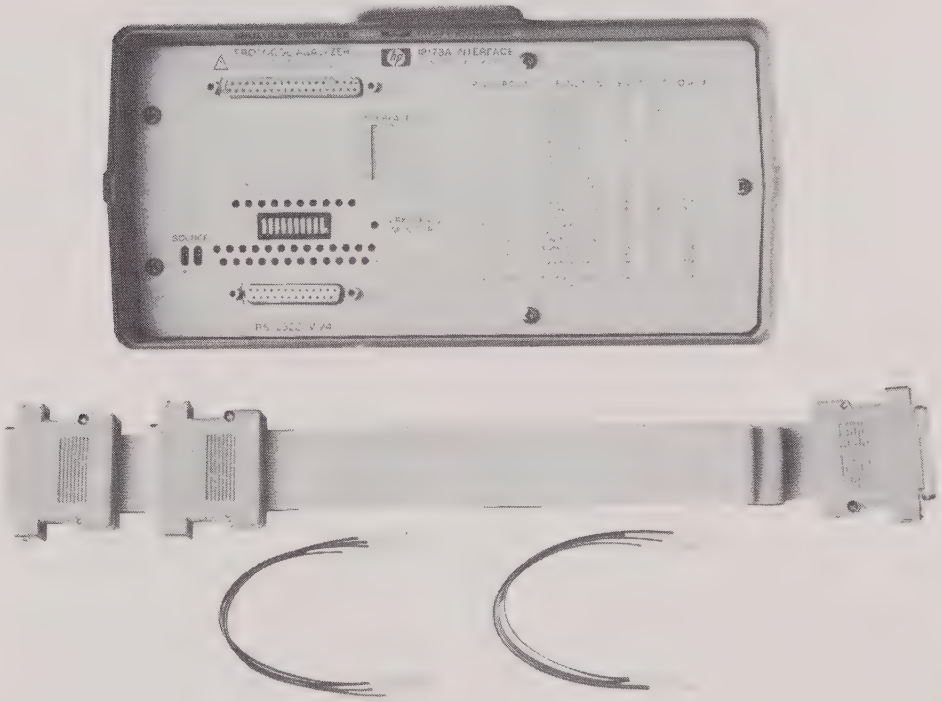


Figure B-1. HP 18173A Interface Pod

B-1. INTRODUCTION

The HP 18173A is an RS-232C/V.24 Interface Pod designed to provide the connection between the HP 4951 Protocol Analyzer and the Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18173A is compatible with CCITT V.24 and EIA RS-232C electrical, mechanical, functional, and procedural specifications.

This appendix includes information to install, operate, and service the HP 18173A.

B-2. INSTALLATION

To connect the Interface Pod to the HP 4951 Protocol Analyzer, turn off the power and attach the 37 pin connector to the port on the back of the Protocol Analyzer as shown in Figure B-2. Tighten the hex screws to ensure that the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

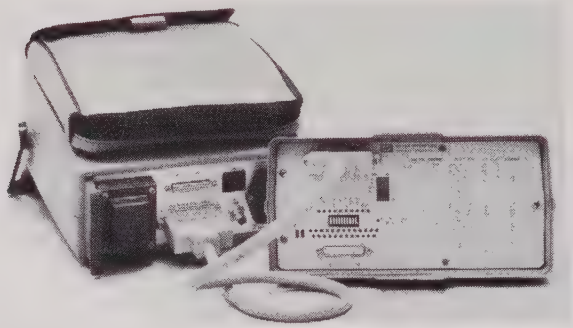


Figure B-2. HP 18173A Interface Pod Connections

B-3. OPERATION

Once the Interface Pod cable is installed, all operations are performed from the keyboard. See the Operating Manual for the procedures.

B-4. PERFORMANCE VERIFICATION

The Performance Verification test is performed by the operator. Follow the procedure described in paragraph B-5.

B-5. HP 18173A Self Test

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. When the <EXT DLC> softkey is pressed, the Interface Pod test will be performed.

2. If there are no failures, DLC TEST PASSED is displayed.

B-6. ADJUSTMENTS

There are no adjustments for the HP 18173A.

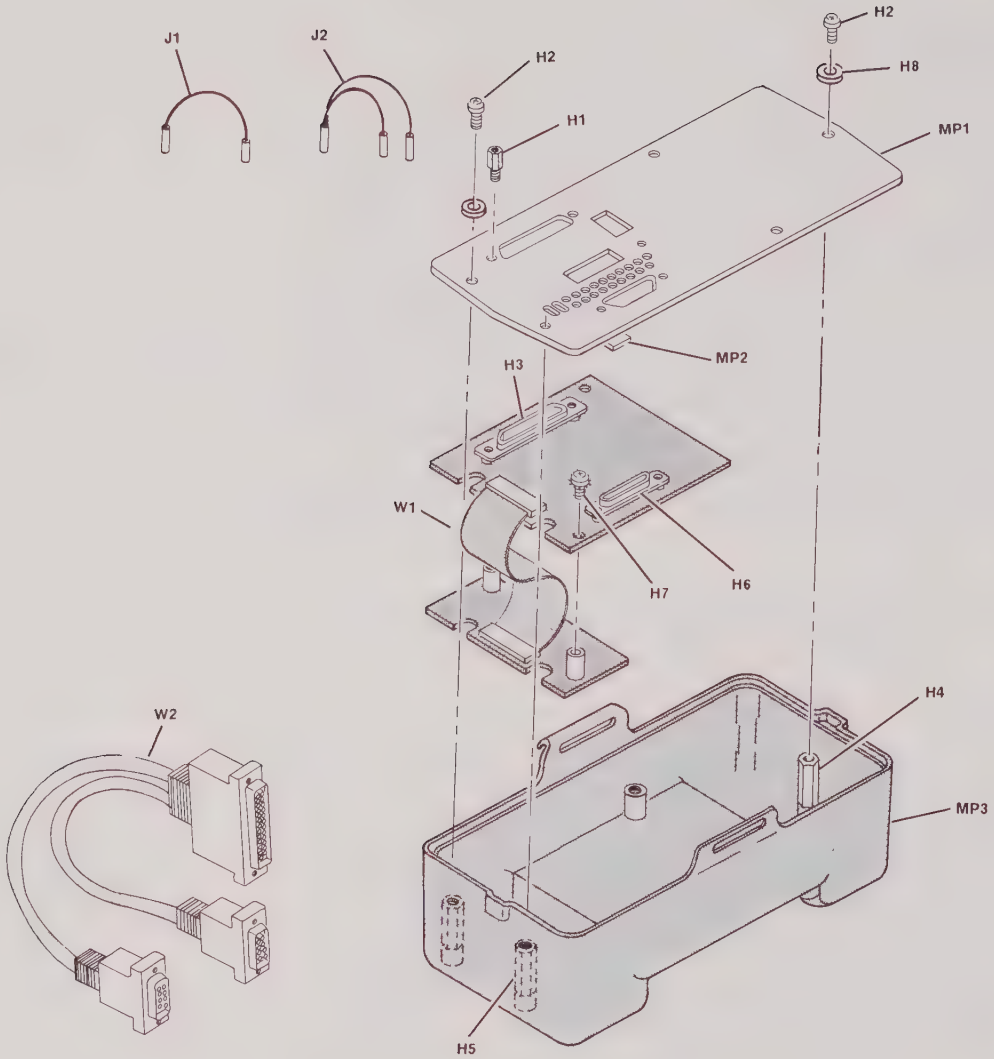
B-7. REPLACEABLE PARTS

The following tables and figure give information for ordering replacement parts. Table B-1 is the Manufacturer's Code List. Figure B-3 lists the replaceable parts in Number, and Manufacturers Part Number. Chassis and mechanical parts are listed in Figure B-2. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table B-1. HP 18173A Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247



H1	1251-2942	4	4	SCREW POST LOCK	01380	206509-1
H2	2360-0195	3	3	SCR, MCH, 6-32-312	04771	ORDER BY DESCR
H3	1251-6074	4	4	CONNECTOR-37 PIN	04486	DC375V
H4	0380-1719	6	1	STANDOFF	28480	0380-1719
H5	1251-4946	5	1	CONNECTOR-25 PIN	04486	DB-255V
H6	0380-1720	9	2	STANDOFF	28480	0380-1720
H7	2360-0115	8	2	SCR MCH 6-32-312	00000	ORDER BY DESCR
H8	2190-0876	3	5	WASHER, FLAT, #6	00000	ORDER BY DESCR
J1	8120-4218	4	4	CABLE, JUMPER	28480	8120-4218
J2	8120-4219	5	2	CABLE JUMPER	28480	8120-4219
MP1	18173-00001	3	1	RS-232C PANEL	28480	18173-00001
MP2	5040-4478	5	1	LENS	28480	5040-4478
MP3	5041-6749	4	1	HOUSING, COATED	28480	5041-6749
W1	18173-61601	3	1	CABLE INTERCONNECT	28480	18173-61601
W2	18173-61602	5	1	CABLE, RS-232C	28480	18173-61602

Figure B-3. HP 18173A Exploded View

Table B-2. HP 18173A Replaceable Parts List

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	18173-60001	8	1	RS-232C INTERFACE POD	28480	18173-60001
A1C1	0180-1746	5	3	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C4	0160-5299	9		CAPACITOR-FXD .022UF+-20% 50VDC	02010	MD011C223MAA
A1C5	0160-5299	9		CAPACITOR-FXD .022UF+-20% 50VDC	02010	MD011C223MAA
A1C6	0160-5299	9		CAPACITOR-FXD .022UF+-20% 50VDC	02010	MD011C223MAA
A1C7	0160-5299	9		CAPACITOR-FXD .022UF+-20% 50VDC	02010	MD011C223MAA
A1C8	0160-5299	9		CAPACITOR-FXD .022UF+-20% 50VDC	02010	MD011C223MAA
A1C9	0180-1846	6	2	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C10	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C11	0160-0576	5	9	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C12	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C18	0180-3050	8	1	CAPACITOR-FXD 330UF+50-10% 16VDC AL	28480	0180-3050
A1C19	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C20	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1E105	1251-8360	5	2	CONNECTOR-SGL PIN	28480	1251-8360
A1E208	1251-8360	5		CONNECTOR-SGL PIN	28480	1251-8360
A1J1	1251-6074	4	1	CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A1J2	1251-4946	5	1	CONNECTOR 25-PIN F D SUBMIN	28480	1251-4946
A1K1	0490-1354	8	1	RELAY 2C 5VDC-COIL 2A 250VAC	28480	0490-1354
A1K2	0490-1383	3	2	RELAY 4C 5VDC-COIL 2A 250VAC	28480	0490-1383
A1K3	0490-1383	3		RELAY 4C 5VDC-COIL 2A 250VAC	28480	0490-1383
A1R1	0699-0556	2	3	RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R2	0699-0556	2		RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R3	0699-0556	2		RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R4	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R5	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1R6	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1R7	0698-3453	2	1	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A1R8	0698-3158	4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A1R9	0698-3266	5	2	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R10	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R11	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A1R12	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A1R13	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A1R14	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A1R15	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A1R16	0698-8820	7	1	RESISTOR 4.64 1% .125W F TC=0+-100	28480	0698-8820
A1R100	1810-0292	2	1	NETWORK-RES 14-DIP220.0 OHM X 7	01121	314B221
A1R200	1810-0679	9	10	RES NETWK SIP 4	28480	1810-0679
A1R201	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R202	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R300	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R301	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R302	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R400	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R401	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R402	1810-0731	9	1	NETWORK-RES SIP 10.0K OHM X 7	28480	1810-0731
A1R500	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R501	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R601	1810-0368	3	1	NETWORK-RES 6-SIP10.0K OHM X 5	01121	206A103
A1R602	1810-0206	8		NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A1U103	1820-3007	4	3	IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U201	1826-0759	9	3	IC COMPARATOR GP QUAD 14-DIP C PKG	04713	LM339J
A1U301	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A1U302	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U303	1990-0883	7	1	DISPLAY-LIQ-XTAL	28480	1990-0883
A1U400	1858-0047	5	1	TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A1U401	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A1U402	1820-3081	4	1	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U503	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U600	1826-0753	3	2	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U603	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL CLEAR DUAL	28480	1820-3373
A1U700	1826-0753	3		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U703	1820-3396	4	1	IC GATE CMOS/74HC AND-OR-INV DUAL 2-INP	28480	1820-3396
	0380-0162	1	2	STANDOFF-RVT-ON .75-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	0380-0332	7	4	STANDOFF-RVT-ON .187-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A1XJ400	1251-8360	5	36	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1XJ503	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1XJ504	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1S501	3101-2732	8	1	DIP SWITCH	28480	3101-2732
	18173-61601	6	1	BD INTERCONN CBL	28480	18173-61601
	1251-7642	4	1	KEYING PLUG	01380	206509-1
	1260-0445	0	2	SQUARE PINS, .425 IN LONG	03206	65500-109
	1251-2942	7		SCREW LOCK POST	04507	318-15-99-011

B-8. SERVICE

The following paragraphs contain service information for the HP 18173A. Included is the Theory of Operation, RS-232C/V.24 Signal Mnemonics, Troubleshooting, Component Locators, and Schematics.

B-9. THEORY OF OPERATION

The Interface Pod has the following capabilities:

1. It translates voltages to and from RS-232C and HP 4951 logic levels.
2. It displays EIA line signal status (of selected lines only).
3. The HP 4951 can program the HP 18173A to monitor data lines and simulate DTE or DCE equipment.
4. The HP 18173A automatically identifies itself to the HP 4951.
5. The breakout box is a part of the Interface Pod.

The HP 18173A is connected to the HP 4951 by a 37 pin connector. Connection to the device under test is through a Y-cable. There are three circuits which control the Interface Pod: the DLC (on HP 4951 Main Board), the Receivers, and the Drivers.

B-10. DLC. The DLC is an I/O device located on the HP 4951 Main Board that controls all communications between the HP 4951 and the Interface Pods. The HP 4951 operates in three modes.

1. Monitor mode, the HP 4951 monitors traffic on a communication line.
2. DTE simulate, the HP 4951 drives the data lines and acts as a terminal.
3. DCE simulate, the HP 4951 drives the data lines and acts as the digital side of a modem or another piece of Data Circuit-Terminating Equipment.

Interface Pod latch A1U204 and an output signal from A1J2 pins 18, 19, and 37 configure the Interface Pod for the correct mode of operation.

B-11. Receivers. Receivers A1U201, A1U301, and A1U401 translate voltage levels from RS-232C to HP 4951 Protocol Analyzer logic levels. The mark and space thresholds are +0.25 and +2.75 volts respectively. These thresholds also provide 2.5 volts of hysteresis at the physical interface lines. The receivers operate correctly over an input voltage range of -15 volts to +25 volts and are protected against voltages between -60 and +90 volts by an input voltage divider network.

B-12. Drivers. RS-232C drivers A1U600 and A1U700 translate the voltage from HP 4951 logic levels to RS-232C levels. The outputs are current limited with a series resistor to protect against driver contentions or unintentional shorts to ground in the power supply. The drivers are connected to the RS-232C interface via latching relays A1K1, A1K2, and A1K3. The relays are software controlled through the Interface Pod output latch.

Status of the EIA lines is shown on an LCD display on the Interface Pod. Control Line bar indicators are turned on when the control line is ON. The transmit and receive clock and data indicators flash at a 2 Hz rate when edge transitions are detected.

Two of the LCD indicators provide valid mark and space threshold information. RS-232C mark and space thresholds are 3 and -3 volts respectively. A mark/space LCD detect can be connected to any incoming EIA line. When the voltage applied to this input is a valid mark or space, the appropriate indicator turns on. If the voltage is between the two thresholds, neither indicator turns on.

B-13. RS-232C SIGNAL MNEMONICS

The HP 18173A is designed to accomodate two similar interface standards, the RS-232C and the V.24. Table B-3 describes RS-232C/V.24 signal mnemonics.

Table B-3. RS-232C/V.24 Signal Mnemonics

CONNECTOR PIN NO	SIGNAL EIA	MNEMONICS CCITT	HP 4951 DISPLAY	DESCRIPTION
1	AA	101		Protective Ground
2	BA	103	TD	Transmitted Data
3	BB	104	RD	Received Data
4	CA	105	RTS	Request To Send
5	CB	106	CTS	Clear To Send
6	CC	107	DSR	Data Set Ready
7	AB	102	GND	Signal Ground
8	CF	109	CD	Carrier Detect (Received Line Signal Detector
9				unassigned
10				unassigned
11				unassigned
12	SCF	122	SCD	Secondary Carrier Detect
13	SCB	121	SCS	Secondary Clear to Send
14	SBA	118	STX	Secondary Transmitted Data
15	DB	114	TC	Transmit Signal Elements Timing (transmit clock)
16	SBB	119	SRX(SRD)	Secondary Received Data
17	DD	115	RC	Receiver Signal Element (Receive Clock)
18				unassigned
19	SCA	120	SRS	Secondary Request to Send
20	CD	108.2	DTR	Data Terminal Ready
21	CG	110	SQ	Signal Quality
22	CE	125	RI	Ring Indicator
23	CH/CI	111/112	DSR	CH=Data Signal Rate Selector, DTE CI=Data Signal Rate Selector, DCE
24	DA	113	XTC	Transmit Signal Element Timing (DTE source)
25				unassigned

B-14. TROUBLESHOOTING

Before troubleshooting the HP 18173A Interface Pod, verify that the HP 4951 is functioning correctly. Troubleshoot the portion of the Interface Pod that has failed. Table B-4 is the DCE test program and Table B-5 is the DTE test program. When entering the program, "Press" indicates that the key is on the keyboard and "Select" indicates a softkey. Follow the test procedure given after each table.

Table B-4. DCE Test Program

Select	SET UP	
	SDLC	(Protocol)
	ASCII 8	(Code)
	DCE	(DTE clock)
	SYNC	(Mode)
	9600	(Bits/sec)
	D & S	(Disp mode)
Press	(HALT)EXIT	

The Top Level Menu will be displayed

Select	SIMULATE
	DCE
Press	MORE
Select	SET LEAD
	CTS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DSR
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	CD
	OFF
	AND THEN
	SEND
Type in	CTS OFF
Press	RTN

Table B-4. DCE Test Program (continued)

Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	CTS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	DSR
	ON
	AND THEN
Press	MORE
	SET LEAD
	CD
	ON
	AND THEN
	SEND
Type in	CTS ON
Press	RTN
Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	CTS
	ON
	THEN GOTO
Type in	Block 1
Press	RTN
	(HALT)EXIT

B-15. DCE Test Procedure

CAUTION

Turn off the HP 4951 when connecting or disconnecting any Interface Pod or jumpers

1. Connect jumpers between the following pins:

   RD and TD
   DSR and DTR and CD
   CTS and RTS

2. Run the program entered in Table B-4.

   Select RUN MENU
   SIMULATE

   a. All lines on the HP 4951 display should be active.

   b. Check the HP 18173A LCD display. TD, RD, TC, and RC should be blinking. DTR, DSR, RTS, CTS, and CD should be on and ON and OFF should be off (-- is never active).

   c. If there are any segments that are not correct, troubleshoot that part of the HP 18173A circuitry.

B-16. DTE Troubleshooting

Table B-5 is the DTE test program. When entering the program, "Press" indicates that the key is on the keyboard and "Select" indicates a softkey. Follow the test procedure given after the table.

Table B-5. DTE Test Program

Select	SET UP	
	SDLC	(Protocol)
	ASCII 8	(Code)
	DTE	(DTE clock)
	SYNC	(Mode)
	9600	(Bits/sec)
	D & S	(Disp mode)
Press	(HALT)EXIT	

The Top Level Menu will be displayed

Table B-5. DTE Test Program

Select	SIMULATE
	DTE
Press	MORE
Select	SET LEAD
	RTS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DTR
	OFF
	AND THEN
	SEND
Type in	RTS OFF
Press	RTN
Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	RTS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	DTR
	ON
	AND THEN
	SEND
Type in	RTS ON
Press	RTN
Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	RTS
	ON
	THEN GOTO
Type in	block 1
Press	RTN
	(HALT)EXIT

B-17. DTE Test Procedure

CAUTION

Turn off the HP 4951 when connecting or disconnecting any Interface Pod or jumpers.

1. Connect jumpers between the following pins:

   RD and TD
   RTS and CTS
   DTR and DSR and CD

2. Enter and run the program entered in Table B-5.

   Select RUN MENU
   SIMULATE

   a. All of the lines on the CRT should be active except DCE.

   b. TD, RD, and TC should be blinking. DTR, DSR, RTS, CTS, and CD should be on and OFF and ON should be off (-- is never on).

3. If any of the above conditions fail, check the following.

   a. The inputs to A1U600 and A1U700 should be at TTL levels (between 0 and +5 volts).

   b. The outputs from A1U600 and A1U700 should be RS-232C levels (+-12 V).

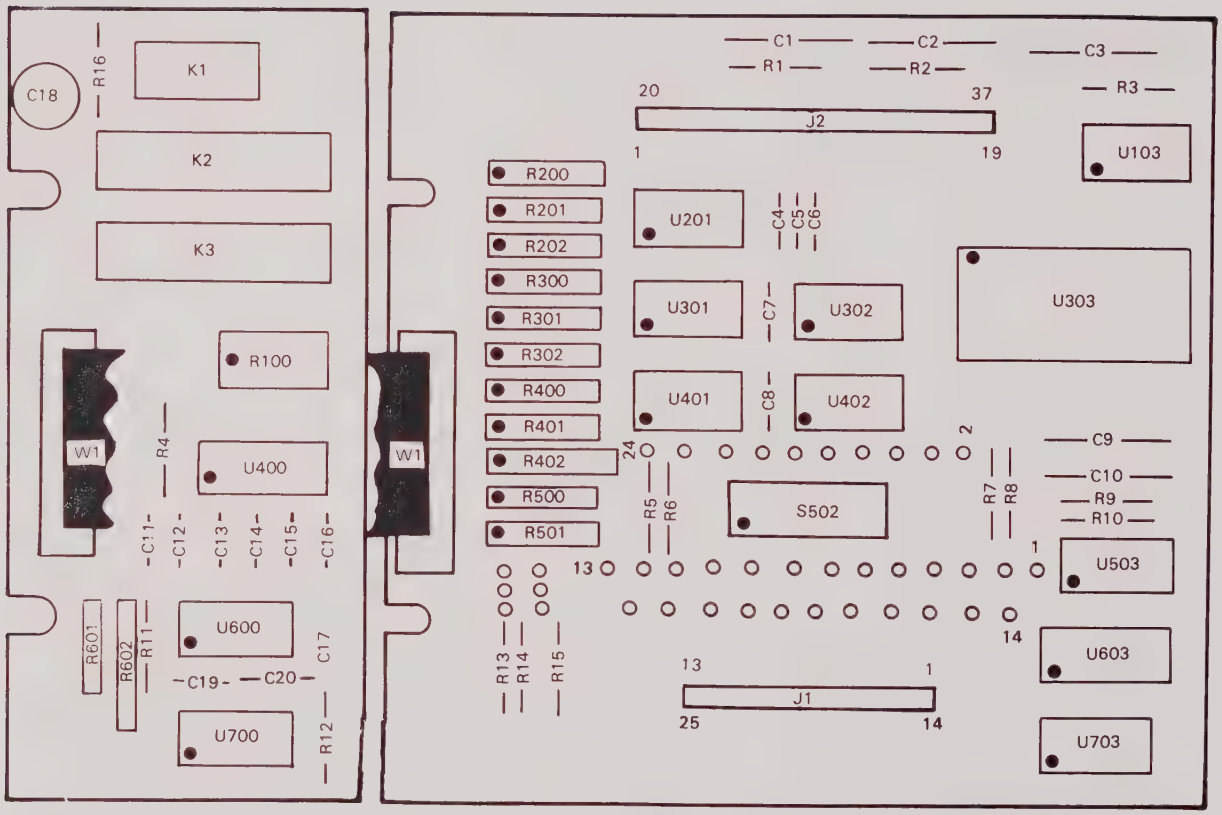
   c. The inputs and outputs of all other circuits should be at TTL levels. Check for correct amplitudes and pulsing signals in all cases.

   d. To check the OFF LCD, connect -12 VTP to the MARK/SPACE TP. The OFF LCD segment should turn on.

   e. To check the ON LCD, connect pin 7 on the Breakout Box to pin 11, A1U401. The ON LCD segment should turn on.

   f. A1U400, the relay circuit is pulsed only once to latch in the correct relay.

   g. If the problem is in the Monitor program, ignore A1U600 and A1U700.



18173-60001-0112-2-84

Figure B-4. HP 18173A Component Locator

APPENDIX C
HP 18174A
RS-449 INTERFACE POD

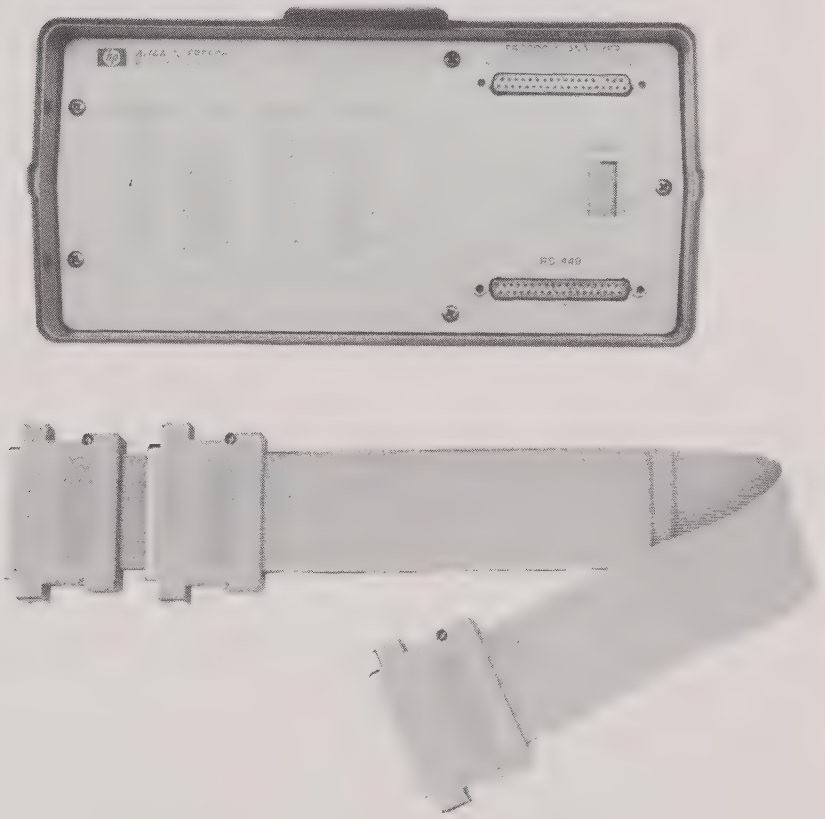


Figure C-1. HP 18174A Interface Pod

C-1. INTRODUCTION

The HP 18174A is an RS-449 Interface Pod designed to provide the connection between the HP 4951 Protocol Analyzer and Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18174A is compatible with EIA RS-449/422A/423A electrical, mechanical, functional, and procedural specifications.

This appendix includes information to install, operate, and service the HP 18174A.

C-2. INSTALLATON

To connect the Interface Pod to the HP 4951 Protocol Analyzer, turn the power off and attach the 37 pin connector to the port on the back of the Protocol Analyzer as shown in Figure C-2. Tighten the hex screws to ensure that the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

Figure C-2. HP 18174A Interface Pod Connections

C-3. OPERATION

Once the Interface Pod is installed, all operations are performed from the keyboard. See the Operating Manual for procedures.

C-4. PERFORMANCE VERIFICATION

The Performance Verification test is performed by the operator. Follow the procedure described in paragraph C-5.

C-5. HP 18174A Self Test

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. When the <EXT DLC> softkey is pressed, the Interface Pod test is automatically performed.

2. If there are no failures DLC TEST PASSED will be displayed.

C-6. ADJUSTMENTS

There are no adjustments for the HP 18174A.

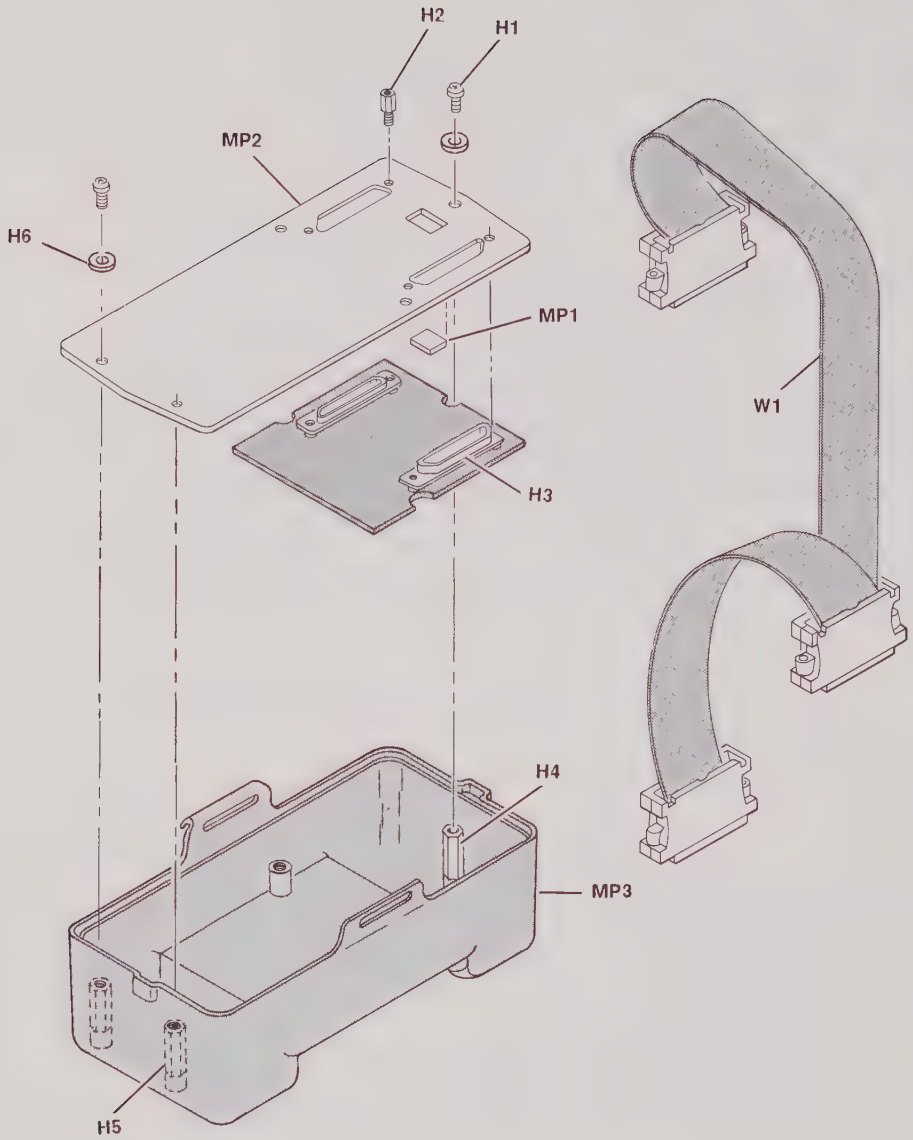
C-7. REPLACEABLE PARTS

The following tables and figure give information for ordering replacement parts. Table C-1 is the Manufacturer's Code List. Table C-2 lists the replaceable parts in alphanumeric order. Information is given for the description, Quantity, HP Part Number, and Manufacturers Part Number. Chassis and mechanical parts are listed in Figure C-3. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table C-1. HP 18174A Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H1	2360-0195	3	5	SCR, MCH, 6-32-312	04771	ORDER BY DESCRIPTION
H2	1251-2942	4	4	SCR POST LOCK	01380	206509-1
H3	1251-6074	4	2	CONNECTOR-37 PIN	04486	DC375V
H4	0380-1719	6	1	STANDOFF	28480	0380-1719
H5	0380-1720	9	2	STANDOFFS	28480	0380-1720
H6	2190-0876	3	5	WASHER, FLAT, #6	00000	ORDER BY DESCRIPTION
MP1	5040-4478	5	1	LENS	28480	5040-4478
MP2	18174-00001	5	1	RS-449 PANEL	28480	18174-00001
MP3	5041-6749	4	1	HOUSING, COATED	28480	5041-6749
W1	18174-61601	8	1	CABLE, RS-449	28480	18174-61601
J1	8120-4218	4	4	CABLE JUMPER	28480	8120-4218
J2	8120-4219	5	2	CABLE JUMPER	28480	8120-4219

Figure C-3. HP 18174A Exploded View

Table C-2. HP 18174A Replaceable Parts List

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1	18174-60003	1	1	RS-449 POD	28480	18174-60003
A1C1	0180-1846	6	2	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C2	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C3	0180-1746	5	2	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C4	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C5	0160-0576	5	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1DS1	1990-0883	7	1	DISPLAY-LIQ-XTAL	28480	1990-0883
A1J1	1251-6074	4	2	CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A1J2	1251-6074	4		CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A1R1	0698-3266	5	2	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R2	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R3	0699-0556	2	2	RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R4	0699-0556	2		RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R5	0757-0442	9	2	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R201	1810-0680	2	10	RES NETWK SIP 2	28480	1810-0680
A1R202	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R203	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R204	1810-0732	5	1	NETWORK-RES 10.0K OHM X 5	28480	1810-0732
A1R301	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R302	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R303	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R304	1810-0369	4	2	NETWORK-RES 6 SIP100.0K OHM X 5	11236	750-61-R100K
A1R401	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R402	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R403	1810-0780	3	2	RES NETWK SIP 2	28480	1810-0780
A1R404	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R405	1810-0780	3	2	RES NETWK SIP 2	28480	1810-0780
A1U100	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL CLEAR DUAL	28480	1820-3373
A1U101	1820-3396	4	1	IC GATE CMOS/74HC AND-OR-INV DUAL 2-INP	28480	1820-3396
A1U103	1820-3081	4	1	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U104	1820-3007	4	3	IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U200	1826-0759	9	3	IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A1U202	1820-2831	0	3	ICD 75174 DRIVER	28480	1820-2831
A1U300	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A1U302	1820-2831	0		ICD 75174 DRIVER	28480	1820-2831
A1U400	1826-0759	9		IC COMPARATOR GP QUAD 14 DIP-C PKG	04713	LM339J
A1U402	1820-2831	0		ICD 75174 DRIVER	28480	1820-2831
A1U403	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U404	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
	0380-0332	7	4	STANDOFF-RVT-ON .187-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
	1251-7642	4	1	KEYING PLUG	28480	1251-7642

C-8. SERVICE

The following paragraphs contain service information for the HP 18174A. Included is the Theory of Operation, RS-449 Signal Mnemonics, Troubleshooting, Component Locators, and Schematics.

C-9. THEORY OF OPERATION

The HP 4951 operates in three modes.

1. Monitor mode: The HP 4951 monitors traffic on a communication line.
2. DTE simulate: The HP 4951 drives the data lines and acts as a terminal.
3. DCE simulate: The HP 4951 drives the data lines and acts as the digital side of a modem or another piece of Data Circuit-Terminating Equipment.

The Interface Pod is configured for the correct mode of operation by output signals from pins 18, 19, and 37 of the connector between the Interface Pod and the Protocol Analyzer.

The RS-449 Interface Pod has the following capabilities.

1. Translates voltages to and from RS-449 and HP 4951 logic levels.
2. Displays EIA line signal status (of selected lines only).
3. Programmable for monitoring and DTE or DCE simulation.
4. Identifies the type of Interface Pod connected to the HP 4951.
5. Supports differentially driven category I circuits.

C-10. DLC. Drivers A1U1 and A1U2 convert the signal from single ended logic levels to a differential voltage waveform. These drivers are tristate devices and need no relays to isolate them from the interface when in the monitor mode.

Receivers A1U10 and A1U11 operate over a common mode voltage range from -7 to +7 volts and require a minumum differential of 200 mvolts to change states. They maintain operation over a differential voltage range from 200 mvolts to 6 volts; however, the positive common mode signal voltage cannot exceed the RS-449 specification of 10 volts. A1U10 and A1U11 are protected by divider resistors from signal levels up to 12 volts.

The EIA status of the selected interface lines is displayed on a bargraph LCD. Clock and data indicators are flashed at a 2Hz rate when line state transitions are detected. Table C-3 lists these RS-449 lines.

Table C-3. RS-449 Description

TR	Terminal Ready
DM	Data Mode
RS	Request to Send
CS	Clear to Send
RR	Receiver Ready
SD	Send Data
RD	Receive Data
RT	Receive Timing

Table C-4. RS-449 Signal Mnemonics

	CONNECTOR PIN NO.	DISPLAY MNEMONICS RS-449	DISPLAY MNEMONICS HP 4951	DESCRIPTION
	1		open	open
	2	SI	SI	Signaling-rate Indicator
	3		open	open
*	4	DTE	SDa	Send Data (a)
	5	ST	STa	Send Timing (a)
*	6	DCE	RDa	Receive Data (a)
*	7	RS	RSa	Request to Send (a)
	8	RT	RTa	Receive Timing (a)
*	9	CS	CSa	Clear to Send (a)
	10	open	open	
*	11	DM	DMa	Data Mode (a)
	12	TR	TRa	Terminal Ready (a)
*	13	RR	RRa	Receiver Ready (a)
	14	RL	RL	Remote Loopback
	15	IC	IC	Incoming Call
	16	SF	SF/SR	Select Frequency/ Signaling-rate Selector
	17	TT	TTa	Terminal Timing (a)
	18		open	open
	19		SG	Signal Ground
	20		RC	Receive Common
	21		open	open
	22	DTE	SDb	Send Data (b)
	23	ST	STb	Send Timing (b)
	24	DCE	RDb	Receive Data (b)
	25	RS	RSb	Request to Send (b)
	26	RT	RTb	Receive Timing (b)
	27	CS	CSb	Clear to Send (b)
	28	IS	IS	Terminal in Service
	29	DM	DMb	Data Mode (b)
	30	TR	TRb	Terminal Ready (b)
	31	RR	RRb	Receiver Ready (b)
	32	SS	SS	Select Standby
	33	SQ	SQ	Signal Quality
	34	open	open	
	35	TT	TTb	Terminal Timing (b)
	36		open	open
	37		SC	Send Common

*Indicates lines which parameters can be selected from HP 4951 screen.

C-11. TROUBLESHOOTING

Before troubleshooting the HP 18174A Interface Pod, verify that the HP 4951 is functioning correctly. Troubleshoot the portion of the Interface Pod that has failed. Table C-6 is the DTE test program and Table C-5 the DCE test program. When entering the program, "Press" indicates that the key is on the keyboard and "Select" indicates a softkey. Follow the test procedure given after each table.

Table C-5. DCE Test Program

Select	SET UP	
	SDLC	(Protocol)
	ASCII 8	(Code)
	DCE	(DTE clock)
	SYNC	(Mode)
	9600	(Bits/sec)
	D & S	(Disp mode)

The Top Level Menu will be displayed.

Select	SIMULATE
	DCE
Press	MORE
Select	SET LEAD
	CS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DM
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	RR
	OFF
	AND THEN
	SEND
Type in	CS OFF
Press	RTN

Table C-5. DCE Test Program (continued)

Select	NEXT BLOCK
Press	MORE
	SET LEAD
	CS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	DM
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	RR
	ON
	AND THEN
	SEND
Type in	CS ON
Press	RTN
Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	CS
	ON
	THEN GOTO BLOCK
Type in	1
Press	RTN
	(HALT)EXIT

C-12. DCE Troubleshooting Procedure

1. Run the program entered in Table C-5.

Select	RUN MENU
	SIMULATE

   a. All lines on the HP 4951 CRT should be active except DTE and RS.

   b. Segments RD, SD, and RT should be flashing. Segments CS, DM, and RR should be on and segments SD, RS, and TR should be off.

2. If any of the above conditions fail, troubleshoot that part of the circuitry.

Table C-6. DTE Test Program

Select	SET UP	
	SLDC	(Protocol)
	ASCII 8	(Code)
	DTE	(DTE clock)
	SYNC	(Mode)
	9600	(Bits/sec)
	D & S	(Disp mode)
Press	(HALT)EXIT	

Use the Cursor Up key to scroll to the DTE clock setup

Select	SIMULATE
	DTE
Press	MORE
Select	SET LEAD
	RS
	OFF
	AND THEN
	MORE
	SET LEAD
	TR
	OFF
	AND THEN
	SEND
Type in	RS OFF
Press	RTN

Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	RS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	TR
	ON
	AND THEN
	SEND
Type in	RS ON
Press	RTN

Table C-6. DTE Test Program (continued)

Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	RS
	ON
	THEN GOTO BLOCK
Type in	1
Press	RTN
	(HALT)EXIT

C-13. DTE TROUBLESHOOTING PROCEDURE

1. Run the program entered in Table C-6.

Select	RUN MENU
	SIMULATE

2. Segments SD and ST are flashing, RS and TR are on, and all of the other segments are off (-- is never active).

3. If any of the conditions in step 2 fail, check items a through d.

   a. The inputs to A1U202, A1U302, and A1U402 should be at TTL levels (between 0 and 5 volts).

   b. The outputs to A1U202, A1U302, and A1U402 should be RS-449 levels (+- 12V).

   c. The inputs and outputs of all other circuits should be at TTL levels. Check for correct amplitudes and pulsing signals.

   d. If the problem is in the Monitor program, ignore A1U202, A1U302, and A1U700.

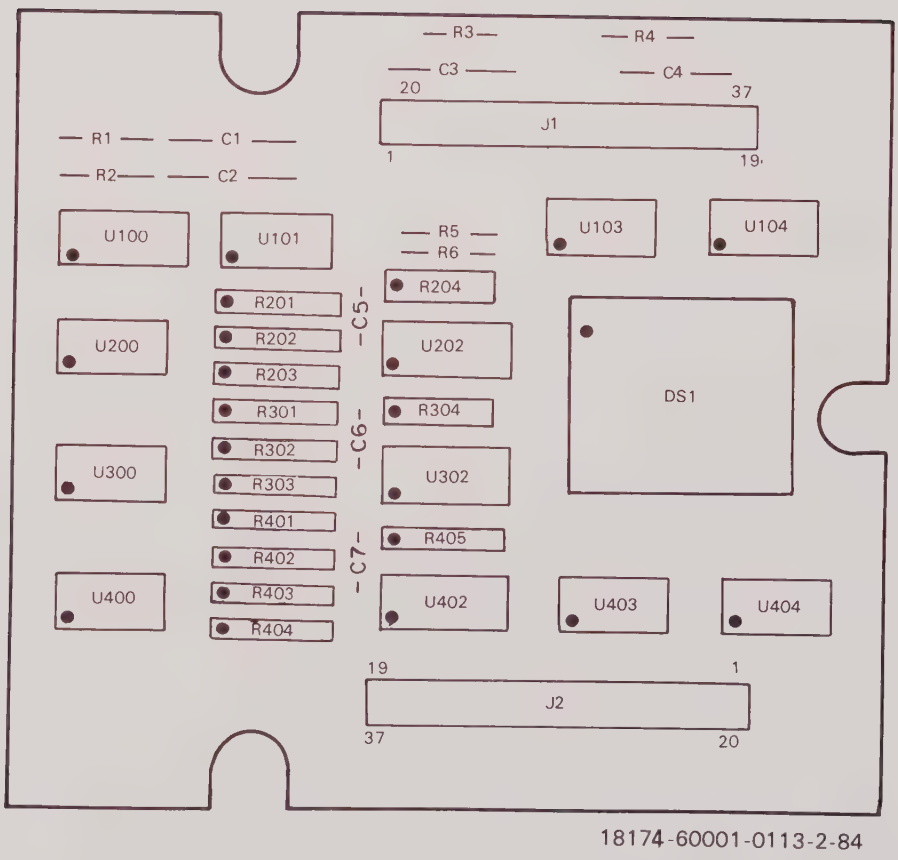


Figure C-4. HP 18174A Component Locator

APPENDIX D
HP 18180A
RS-232C/V.24/RS-449 INTERFACE PODS

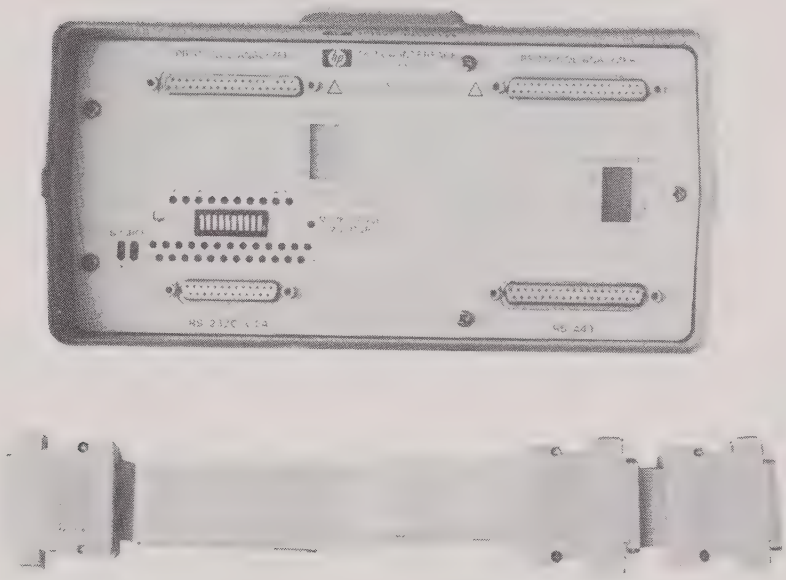


Figure D-1. HP 18180A Interface Pod

D-1. INTRODUCTION

The HP 18180A is an RS-232C/V.24/RS-449 Interface Pod designed to provide the connection between the HP 4951 Protocol Analyzer and the Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18180A contains both the HP 18173A and the HP 18174A Interface Pods. For descriptions, refer to Appendixes B and C.

This appendix includes information to install, operate, and service the HP 18180A.

D-2. INSTALLATION

To connect the Interface Pod to the HP 4951 Protocol Analyzer, turn the power off and attach the 37 pin connector to the port on the back of the Protocol Analyzer. Tighten the hex screws to ensure that the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

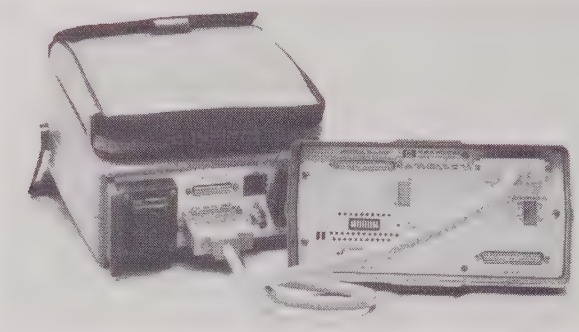


Figure D-2. HP 18180A Interface Pod Connections

D-3. OPERATION

Once the Interface Pod is installed, all operations are performed from the keyboard. See the Operating Manual for procedures.

D-4. PERFORMANCE VERIFICATION

The Performance Verification test is performed by the operator. Follow the procedure described in paragraph D-5.

D-5. HP 18180A Self Test

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. When the <EXT DLC> softkey is pressed, the Interface Pod test is performed.

2. If there are no failures, DLC TEST PASSED is displayed.

D-6. ADJUSTMENTS

The HP 18180A needs no adjustments.

D-7. REPLACEABLE PARTS

To order replacement parts refer to Appendix B for RS-232C/V.24 components and to Appendix C for RS-449 components. Chassis and mechanical parts are listed in Table D-2. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

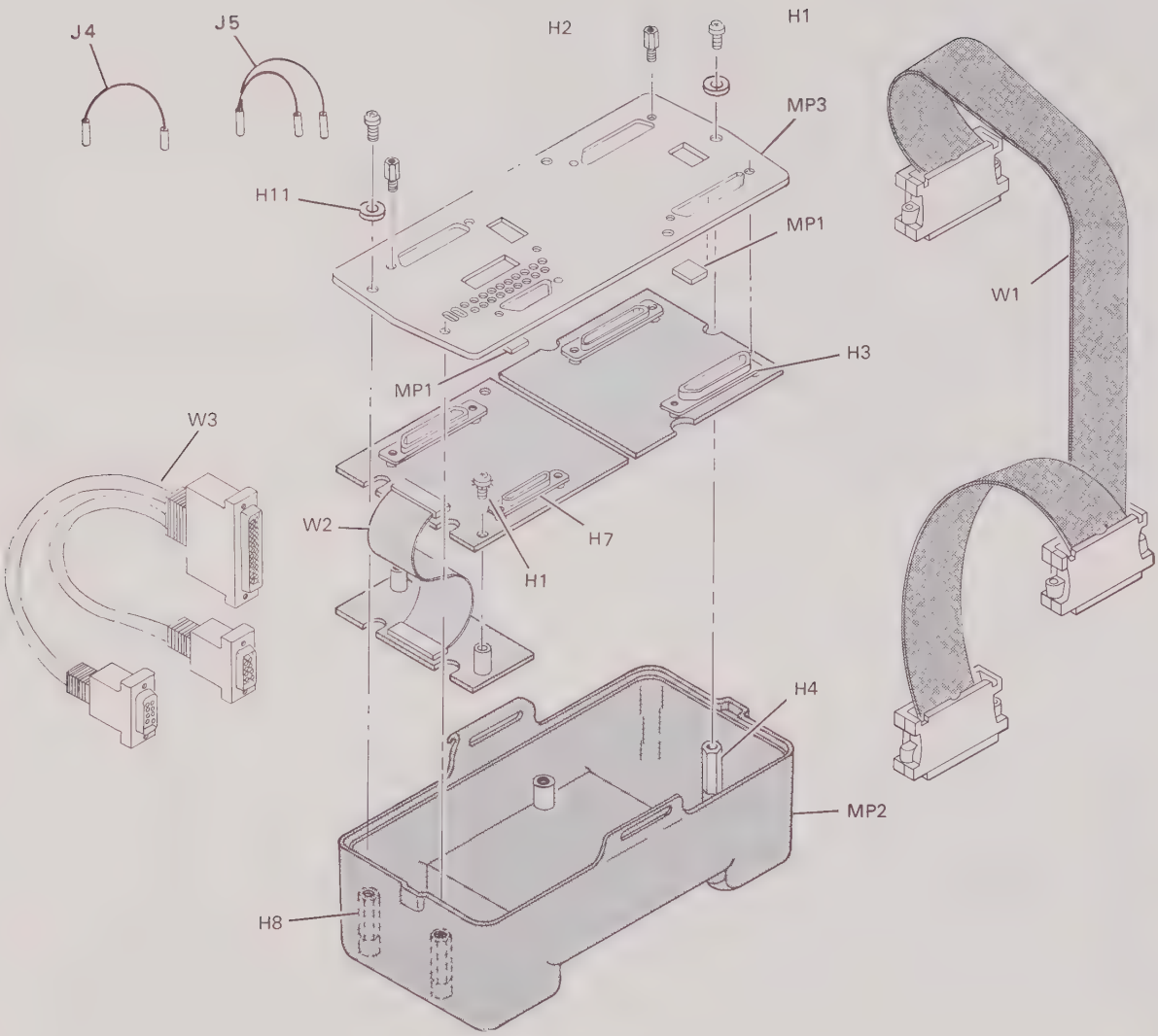
When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table D-1. Manufacturer's Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHONEIX	AZ	85008
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247

Table D-2. Replaceable Parts List

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	18180	4	1	RS-232C.RS-449 POD	28480	18180
	5041-6749	4	1	HOUSING, COATED	28480	5041-6749
	18173-60003	0	1	RS-232C ASSY	28480	18173-60001
	18173-61602	7	1	CABLE, RS-232C	28480	18173-61602
	18174-60003	9	1	RS-449 ASSY	28480	18174-60001
	18174-61601	7	1	CABLE, RS-449	28480	18174-61601
	18180-00001	1	1	RS-232C/RS-449 PNL	28480	18180-00001



Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H1	2360-0195	3	3	SCR, MCH, 6-32-312	04771	ORDER BY DESCRIPTION
H2	1251-2942	4	8	SCR POST LOCK	01380	206509-1
H3	1251-6074	4	2	CONNECTOR-37 PIN	04486	DC375V
H4	0380-1719	6	1	STANDOFF	28480	0380-1719
H5	0380-1720	9	2	STANDOFFS	28480	0380-1720
H6	2360-0115	8	2	SCR MCH 6-32-312	00000	ORDER BY DESCRIPTION
H7	1251-4946	5	1	CONNECTOR 25 PIN	04486	DB-255V
H8	2190-0876	3	5	WASHER, FLAT, #6	00000	ORDER BY DESCRIPTION
MP1	5040-4478	5	1	LENS	28480	5040-4478
MP2	5041-6749	4	1	HOUSING, COATED	28480	5041-6749
MP3	18180-00001	5	1	RS-232C/RS-449 PANL	28480	18180-00001
W1	18174-61601	8	1	CABLE, RS-449	28480	18174-61601
W2	18173-61601	3	1	CABLE INTERCONNECT	28480	18173-61601
W3	18173-61602	5	1	CABLE, RS-232C	28480	18173-61602
J1	8120-4218	4	4	CABLE JUMPER	28480	8120-4218
J2	8120-4219	5	2	CABLE JUMPER	28480	8120-4219

Figure D-3. HP 18180A Exploded View

D-8. SERVICE

The HP 18180A contains both the RS-232C/V.24 and the RS-449 Interface Pods. Service information and schematics are located in Appendix B for RS-232C/V.24 side of the Interface Pod and Appendix C for the RS-449 side of the Interface Pod.

APPENDIX E
HP 18179A
RS-232C/V.24 INTERFACE POD

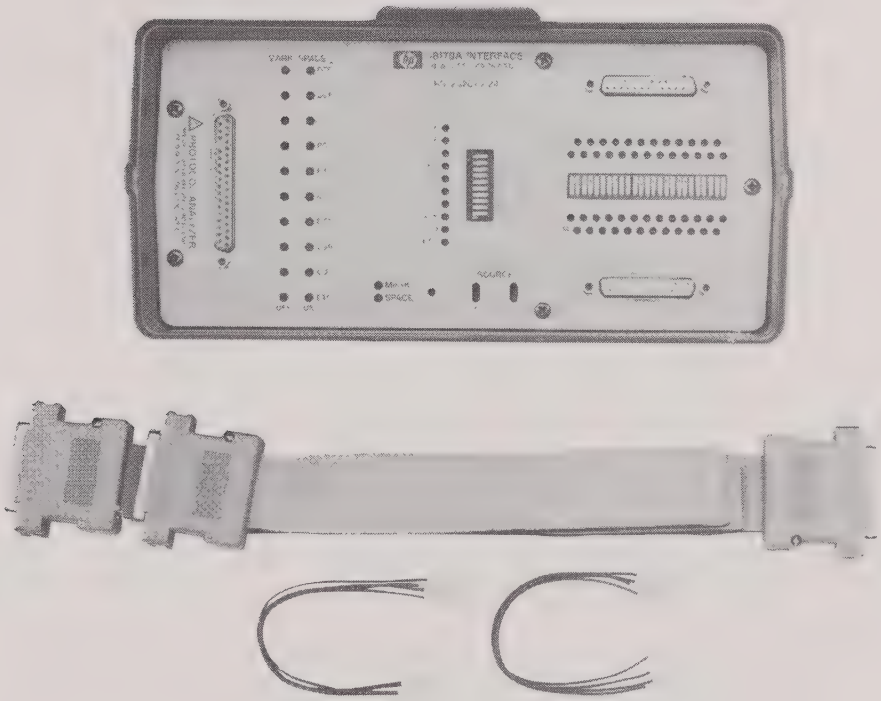


Figure E-1. HP 18179A Interface Pod

E-1. INTRODUCTION

The HP 18179A is an RS-232C/V.24 Interface Pod designed to provide the connection between the HP 4951 Protocol Analyzer and Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). It supports three modes of operation: monitor, DTE simulate, and DCE simulate. The HP 18179A is compatible with CCITT V.24 and EIA RS-232C electrical, mechanical, functional, and procedural specifications.

This appendix includes information to install, operate, and service the HP 18179A.

E-2. INSTALLATION

To connect the Interface Pod to the HP 4951 Protocol Analyzer, turn off the power and attach the Interface Pod connector to the port on the back of the Protocol Analyzer. Tighten the hex screws to ensure that the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

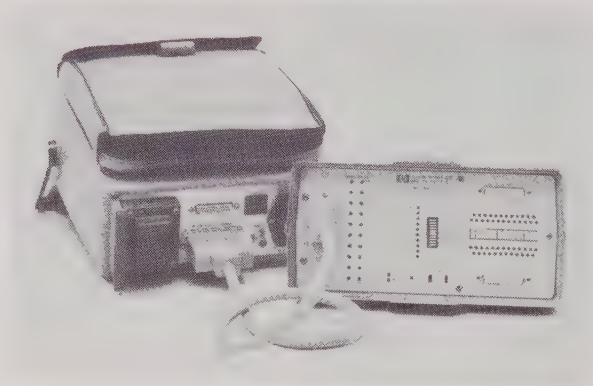


Figure E-2. HP 18179A Interface Pod Connections

E-3. OPERATION

This section describes the front panel controls, indicators, and connectors, as well as operation of the HP 18179A Interface Pod. Read the description of the front panel controls, indicators, and connectors before operating the instrument.

E-4. Controls, Indicators, and Connectors

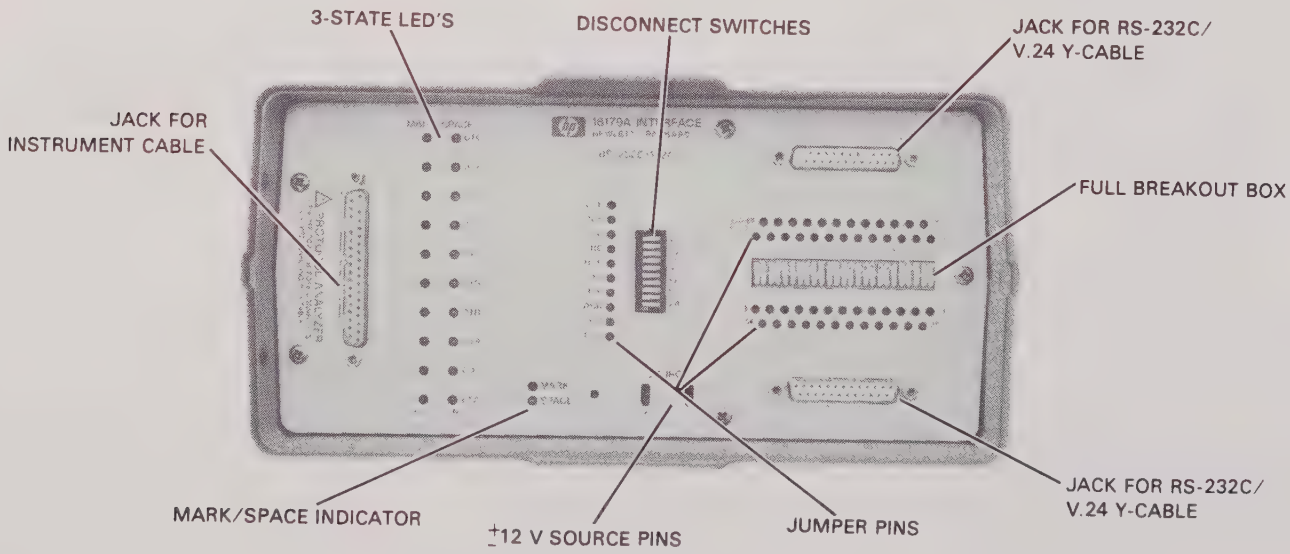


Figure E-3. HP 18179A Front Panel

3-state LEDS

The 3-state indicators indicate activity on the lines and RS-232C compliance.

green: space (logic '0', positive voltage)
turns on at >2.75 V, turns off at <0.25 V

red: mark (logic '1', negative voltage)
turns on at < -3.0 V, turns off at > -3.0 V

Disconnect Switches

Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, and 24 may be individually disconnected from the data link by switches. This lets you isolate non-driven interface lines from the HP 4951. Non-driven lines may develop cross talk noise which will be mistaken by the analyzer for transitions.

Jacks for RS-232C/V.24 Y-cable

These jacks connect the Interface Pod to the line for monitoring or simulation.

Full Breakout Box

The Breakout Box provides crosspatching, lineforcing, and monitoring capabilities for all of the RS-232C lines. The miniature switches isolate lines.

Jumper Pins

All 25 pins of the RS-232C jack are brought out for jumpering. If your network cable has different pin assignments from the interface standard, you can use the supplied jumper wires to connect the interface lines to the desired pin on your cable.

+-12 V Source Pins

The Source Pins supply +12 volts and - 12 volts. You may set any signal line on or off by jumpering that line to the Source Pins.

Mark/Space Indicator

The Mark/Space Indicator enables you to check the level of any signal line. Jumper the line to this pin and the appropriate indicator will light.

Jack for Instrument Cable

This jack connects the Interface Pod to the HP 4951 via the Pod-Instrument cable supplied with this instrument.

E-5. PERFORMANCE VERIFICATION

The Performance Verification test is performed by the operator. Follow the procedure described in paragraph E-6.

E-6. HP 18179A Self Test

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. Turn off all ten switches in the switch block located in the center of the Interface Pod. When the <EXT DLC> softkey is pressed, the Interface Pod test will be automatically performed.

2. If there are no failures, DLC TEST PASSED is displayed.

   a. If there is a failure, the problem may be in the Interface Pod or in the Protocol Analyzer.

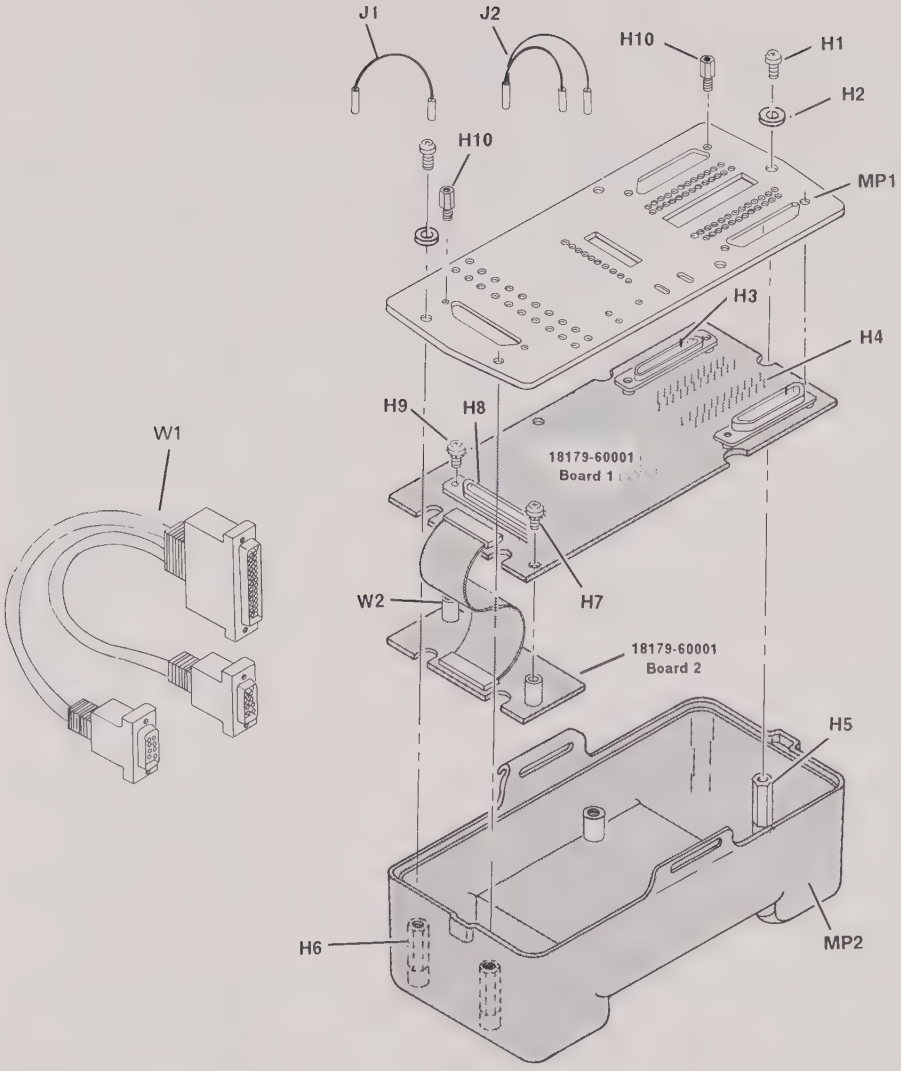
E-7. ADJUSTMENTS

There are no adjustments for the HP 18179A.

E-8. REPLACEABLE PARTS

The following tables and figure give information for ordering replacement parts. Table E-2 is the Manufacturer's Code List. Table E-1 lists the replaceable parts in alphanumeric order. Information is given for the Description, Quantity, HP Part Number, and Manufacturers Part Number. Chassis and mechanical parts are listed in Figure E-4. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.



Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H1	2360-0195	7	5	SCREW, MACHINE 6-32-.312	05610	ORDER BY DESCRIPTION
H2	2190-0876	3	5	WASHER, FLAT #6 MTLC	05313	ORDER BY DESCRIPTION
H3	1251-6074	4	2	CONNECTOR-37 PIN	04486	DC375V
H4	1251-8360	5	67	CONNECTOR POST	01380	8787-6
H5	0380-1719	6	1	STANDOFF-HEX M & F	02121	AL6981-.917-3
H6	0380-1720	9	2	STANDOFF-HEX M & F	02121	AL6981-.803-3
H7	2360-6074	4	2	SCREW, MACHINE 6-32-.312	05610	ORDER BY DESCRIPTION
H8	1251-4946	3	2	CONNECTOR 25 PIN F	04507	DB-255V
H9	2360-0115	4	2	SCREW, MACHINE 6-32-.312	05610	ORDER BY DESCRIPTION
H10	1251-2942	7	4	SCREW POST LOCK	28480	1251-2942
J1	0380-0162	1	2	SPACER 6-32 .750	01461	ORDER BY DESCRIPTION
J2	8120-4218	4	4	CABLE JUMPER	28480	8120-4218
MP1	8120-4219	5	2	CABLE JUMPER	28480	8120-4219
MP2	18179-00001	8	1	SUPERPOD PANEL	28480	18179-00001
	5041-6749	4	1	HOUSING, COATED	28480	5041-6749
W1	18173-61602	7	1	CABLE, RS-232C	28480	18173-61602
W2	18173-61601	1	1	CABLE, BOARD CONN	28480	18173-61601

Figure E-4. HP 18179A Exploded View

Table E-1. HP 18179A Replaceable Parts List

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1C1	0180-3050	8	1	CAPACITOR 330UF 16VDC	08817	16TWI 330RDF
A1C2	0180-0228	6	1	CAPACITOR 22 UF 15V	04200	150D226X9015B2
A1C3	0160-0576	5	19	CAPACITOR .1UF 20% 50V	04200	1C10X7R104M050B
A1C3	0160-0576	6	1	CAPACITOR-FXD .1UF 20% 50v	04200	1C10X7R104M050B
A1C4	0160-0576	6	1	CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C5	0160-5298	4	5	CAPACITOR-FXD 0.01UF 20% 100V	02010	MDO11C103MAA
A1C6	0160-5298	4		CAPACITOR-FXD 0.01UF 20% 100V	02010	MDO11C103MAA
A1C7	0160-5298	4		CAPACITOR-FXD 0.01UF 20% 100V	02010	MDO11C103MAA
A1C8	0160-5298	4		CAPACITOR-FXD 0.01UF 20% 100V	02010	MDO11C103MAA
A1C9	0160-5298	4		CAPACITOR-FXD 0.01UF 20% 100V	02010	MDO11C103MAA
A1C10	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C11	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C12	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C13	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C14	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C15	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C16	0160-0576	5		CAPACITOR FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C17	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C18	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C19	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C20	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C21	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C22	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C23	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C24	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C25	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C26	0160-0576	5		CAPACITOR-FXD .1UF 20% 50V	04200	1C10X7R104M050B
A1C27	0180-0116	1	2	CAPACITOR-FXD 6.8UF 35V	04200	150D685X9035B2
A1C28	0180-0116	1		CAPACITOR-FXD 6.8UF 35V	04200	150D685X9035B2
A1CR1	1990-0486	6	11	LED LAMP, RED	01542	QLMP-1347
A1CR2	1990-0485	9	11	LED LAMP, GREEN	05735	240010GB7
A1CR3	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR4	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR5	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR6	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR7	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR8	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR9	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR10	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR11	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR12	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR13	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR14	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR15	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR16	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR17	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR18	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR19	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR20	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR21	1990-0486	6		LED LAMP, RED	01542	QLMP-1347
A1CR22	1990-0485	9		LED LAMP, GREEN	05735	240010GB7
A1CR500	1906-0074	5	1	DIODE ARRAY	02237	FSA3157P
A1K100	0490-1354	8	1	RELAY-10 PIN PKG	01850	DSZE-M-12-DC5V-H36
A1K200	0490-1383	3	2	RELAY	01850	DS4E-ML2DC5V
A1K300	0490-1383	3		RELAY	01850	DS4E-ML-DC5V
A1R1	0698-8820	7	4	RESISTOR 4.64 1% .125w	05524	F-55-1
A1R2	0698-8820	7		RESISTOR 4.64 1% .125W	05524	CMF-55-1
A1R3	0698-3156	4	1	RESISTOR 14.7K 1% .125W	02995	5033R
A1R4	0757-0442	9	4	RESISTOR 10K 1% .125W	02995	5033R
A1R5	0757-0442	9		RESISTOR 10K 1% .125W	02995	5033R
A1R6	0757-0461	1	1	RESISTOR 68.1K 1% .125	02995	5033R
A1R7	0757-0442	9		RESISTOR 10K 1% .125W	02995	5033R
A1R8	0698-8820	7		RESISTOR 4.64 1% .125w	05524	CMF-55-1
A1R9	0698-8820	7		RESISTOR 4.64 1% .125W	05524	CMF-55-1
A1R10	0757-0442	9		RESISTOR 10K 1% .125W	02995	5033R
A1R11	0757-0465	9	1	RESISTOR 100K 1% .125w	02995	5033R
A1R12	0757-0280	3		RESISTOR 1KOHM 1%	02995	5033R
A1R13	0575-0280	3		RESISTOR 1K OHM 1%	02995	5033R
A1R14	0575-0280	3		RESISTOR 1K OHM 1%	02995	5033R
A1R102	1810-0747	2	2	RESISTOR-NET 330 OHM X7	28480	1810-0747
A1R103	1810-0748	3	2	RESISTOR-NET 220.0 X 7	28480	1810-0748
A1R105	1810-0679	4	11	RESISTOR-NET 10.0K X7	28480	1810-0679
A1R106	1810-0679	4		RESISTOR-NET 10.0K	28480	1810-0679
A1R205	1810-0679	9		RESISTOR-NET 10.0K	28480	1810-0679
A1R206	1810-0679	9		RESISTOR-NET 10.0K	28480	1810-0679

See introduction to this section for ordering information

Table E-1. HP 18179A Replaceable Parts List (continued)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R304	1810-0746	2	3	RESISTOR-NET 100.0 X 4	28480	1810-0746
A1R400	1810-0292	0		RESISTOR-NET SIP 4	28480	1810-0292
A1R404	1810-0745	0	2	RESISTOR-NET 1K X 7	28480	1810-0745
A1R405	1810-0731	4	3	RESISTOR-NET 10.0K X 7	28480	1810-0731
A1R406	1810-0679	9		RESISTOR-NET 10.0K X 7	28480	1810-0679
A1R504	1810-0746	1		RESISTOR-NET 100.0K X 4	28480	1810-0746
A1R505	1810-0731	5		RESISTOR-NET 10.0K X 7	28480	1810-0731
A1R506	1810-0679	4		RESISTOR-NET 10.0K X 7	28480	1810-0679
A1R604	1810-0745	0		RESISTOR-NET 1K X 7	28480	1810-0745
A1R605	1810-0746	2		RESISTOR-NET 100K X 4	28480	1810-0746
A1R606	1810-0679	3		RESISTOR-NET 10.0K X 7	28480	1810-0679
A1R607	1810-0679	3		RESISTOR-NET 10.0K X 7	28480	1810-0679
A1R608	1810-0679	3		RESISTOR-NET 10.0K X 7	28480	1810-0679
A1R700	1810-0731	4		RESISTOR-NET 10.0K X 7	28480	1810-0731
A1R703	1810-0747	2		RESISTOR-NET 330.0 X 7	28480	1810-0747
A1R705	1810-0679	4		RESISTOR-NET 10.0K X 7	28480	1810-0679
A1R706	1810-0679	4		RESISTOR-NET 100.0K X 7	28480	1810-0679
A1R800	1810-0745	0	1	RESISTOR-NET 10K X 5	28480	1810-0745
A1R803	1810-0748	3		RESISTOR-NET 220.0 X 7	28480	1810-0748
A1SW1	3101-2732	8	1	DIP SWITCH	05661	DSS-10
A1SW2	3101-2618	0	1	DIP SWITCH	05735	240005GB
A1SW3	3101-2618	0		DIP SWITCH	05735	240005GB
A1SW4	3101-2619	0		DIP SWITCH	05735	240005GB
A1U105	1858-0047	1	4	TRANSISTOR ARRAY 16 P DIP	02237	FSA3157P
A1U106	1826-0759	9	6	IC - 339	02037	SL44582
A1U305	1820-2921	9	2	IC MM74HC04N	03406	MM74HC04N
A1U306	1826-0759	9		IC - 339	02037	SL44582
A1U307	1826-0753	3	3	IC 34004B	02037	MC34004BL
A1U405	1858-0047	1		TRANSISTOR ARRAY 16 P DIP	02237	FSA3157P
A1U406	1826-0759	9	6	IC - 339	02037	SL44582
A1U600	1826-0753	3		IC 34004B	02037	MC34004BL
A1U605	1820-2921	9		IC MM74HC04N	03406	MM74HC04N
A1U606	1826-0759	9	6	IC - 339	02037	SL44582
A1U700	1826-0753	3		IC 34004B	02037	MC34004BL
A1U701	1858-0047	1	4	TRANSISTOR ARRAY 16 P DIP	02237	FSA3157P
A1U705	1858-0047	1	4	TRANSISTOR ARRAY 16 P DIP	02237	FSA3157P
A1U706	1826-0759	9	6	IC - 339	02037	SL44582
A1U707	1826-0759	9	6	IC - 339	02037	SL44582

Table E-2. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI 53204
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ 85008
11236	CTS OF BERNE INC	BERNE	IN 46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH 03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX 76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA 16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA 94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA 01247

E-9. SERVICE

The following paragraphs contain service information for the HP 18179A. Included is the Theory of Operation, RS-232C/V.24 Signal Mnemonics, Troubleshooting, Component Locators, and Schematics.

E-10. THEORY OF OPERATION

The HP 18179A provides enhanced Level I protocol analysis with three state indicators on ten lines. This is implemented with two comparators per line driving MARK (red) and SPACE (green) LEDs. The HP 18179A can act as a DTE or DCE, or monitor an RS-232C data link. These modes are selected by pulsing the three mode control lines. The control lines activate latching relays which connect the RS-232C drivers to the Breakout Box.

E-11. Breakout Box. The Breakout Box allows access to all 25 lines. The operator can configure the interface by opening the Breakout Box switches and patching lines with jumpers. It has one undedicated MARK/SPACE indicator. The +-12 V sources are current limited with 1 K resistors.

E-12. Specifications. The HP 18179A has the following electrical specifications.

* Steady State curent, each LED on 50% of the time.

+5V	165 mA
+-12 V	30mA

* Interface Pod ID 0,0,0

* LED thresholds

SPACE LED & data	on at 2.75 V, off at 0.25 V
MARK LED	on at -3 V, off at -2.8 V

The Interface Pod has the following features and capabilities:

It translates voltages between RS-232C and HP 4951 logic levels.

It displays the lines status of all EIA lines presented to the HP 4951.

It has an integral Breakout Box.

In monitor mode, the HP 4951 monitors traffic on a data link.

During DTE simulate, the HP 4951 appears as a data terminal device.

During DCE simulate, the HP 4951 appears as a piece of data communication equipment.

The RS-232C drivers will operate into a worst case RS-232C load.

E-13. Simulate Mode. In the DTE and DCE simulate modes RS-232C drivers are switched into the appropriate lead by latching relays.

E-14. Monitor Mode. If monitor mode is selected all RS-232C drivers are disconnected from the line.

E-15. CIRCUIT THEORY

The control lines activate latching relays which connect the RS-232C line drivers to the Breakout Box. All control lines are normally at a logic 0 (0 volts). Programming pulses may occur simultaneously, but it is preferable if they do not.

Monitor	10 ms pulse on J1-18 (monitor)
DTE simulate	10 ms pulse on J1-18 (monitor) 10 ms pulse on J1-19 (DTE simulate)
DCE simulate	10 ms pulse on J1-18 (monitor) 10 ms pulse on J1-37 (DCE simulate)

E-16. Receivers

The RS-232C receivers are implemented with two comparators, one is a data receiver (valid space indicator) and the other a valid mark indicator. The indicators drive green and red LEDs respectively. The data receiver has 0.5 volts of hystersis, this window is between +0.25 V and +2.75 V. The thresholds of the receivers are set by op amp A1U307. The valid mark indicator has hystersis of -0.2 V at -3V to prevent oscillations. The undedicated mark/space indicator has the same thresholds as the dedicated receivers.

E-17. Line Drivers

The RS-232C line drivers are implemented with op amps. The outputs are current limited by a 200 ohm resistor in parallel with a 0.1 uf speed up capacitor to improve the rise time into large cable lengths. Diodes to the +-12 V supplies also protect the outputs of the drivers from foreign voltages.

E-18. RS-232C SIGNAL MNEMONICS

The HP 18179A is designed to accomodate two similar interface standards, the RS-232C and the V.24. Table E-3 describes RS-232C/V.24 signal mnemonics.

Table E-3. RS-232C/V.24 Signal Mnemonics

CON-NECTOR PIN NO	SIGNAL MNEMONICS		DESCRIPTION
	EIA	CCITT	
1	AA	101	Protective Ground
2	BA	103	* Transmitted Data (TD)
3	BB	104	* Received Data (RD)
4	CA	105	* Request To Send (RTS)
5	CB	106	* Clear To Send (CTS)
6	CC	107	* Data Set Ready (DSR)
7	AB	102	Signal Ground
8	CF	109	* Carrier Detect (Received Line Signal Detector, CD)
9			unassigned
10			unassigned
11			unassigned
12	SCF	122	Secondary Carrier Detect
13	SCB	121	Secondary Clear to Send
14	SBA	118	Secondary Transmitted Data
15	DB	114	* Transmit Signal Elements Timing (transmit clock, TC)
16	SBB	119	Secondary Received Data
17	DD	115	* Receiver Signal Element (Receive Clock, RC)
18			unassigned
19	SCA	120	Secondary Request to Send
20	CD	108.2	* Data Terminal Ready (DTR)
21	CG	110	Signal Quality
22	CE	125	Ring Indicator
23	CH/CI	111/112	CH=Data Signal Rate Selector, DTE CI=Data Signal Rate Selector, DCE
24	DA	113	* Transmit Signal Element Timing (DTE source, ETC)
25			unassigned

* Monitored by the HP 18179A indicators.

E-19. TROUBLESHOOTING

Before troubleshooting the HP 18179A Interface Pod, first verify that the HP 4951 is functioning correctly. Troubleshoot the portion of the Interface Pod that has failed. Table E-4 is the DTE test program and Table E-6 the DCE test program. When entering the program, "Press" indicates that the key is on the keyboard and "Select" indicates a softkey. Follow the test procedure given after each table.

Table E-4. DTE Test Program

Select	SET UP	
	SDLC	(Protocol)
	ASCII 8	(Code)
	DTE	(DTE clock)
	SYNC	(Mode)
	9600	(Bits/sec)
	D & S	(Disp mode)
Press	(HALT)EXIT	

The Top Level Menu will be displayed.

Select	SIMULATE
	DTE
Press	MORE
Select	SET LEAD
	RTS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DTR
	OFF
	AND THEN
	SEND
Type in	CTS OFF
Press	RTN (return)
Select	AND THEN
Press	MORE
Select	WAIT
Type in	100
Press	RTN (return)
Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	RTS
	ON
	AND THEN

Table E-4. DTE Test Program (cont)

Press	MORE
Select	SET LEAD
	DTR
	ON
	AND THEN
	SEND
Type in	CTS ON
Press	RTN (return)
Select	AND THEN
Press	MORE
Select	WAIT
Type in	100
Press	RTN (return)
Select	AND THEN
	WHEN TRIG
	LEAD
	RTS
	ON
	THEN GOTO
Type in	1
Press	RETURN
	(HALT)EXIT

E-20. Procedure

CAUTION

Turn off the HP 4951 when connecting or disconnecting any Interface Pod.

1. Connect jumpers between TPB pins 4, 5, and 6 and 8 and 20.
   Close SW4, SW5, SW6, SW8, and SW20.

2. Run the program entered in Table E-4.

Select	RUN MENU
	SIMULATE

   a. Table E-5 describes the status of the HP 18179A indicators.

Table E-5. Indicators on HP 18179A During DTE Troubleshooting

Indicator	MARK	SPACE
DTE	on	on
DCE	off	off
TC	off	off
RC	off	off
RTS	blinking	blinking
CTS	blinking	blinking
DTR	blinking	blinking
DSR	blinking	blinking
CD	blinking	blinking
ETC	on	on

3. If any of the above conditions fail, perform the following.

   a. Use an oscilloscope to examine the transmitter associated with the failed channel. The minimum voltage swing should be +-10 volts. If the trouble is not found, proceed to step b.

   b. Use and osciloscope to examine the receiver associated with the failed channel. The input to the comparators should be 6 volts p-p with a one volt DC offset at the inverting inputs. All of the other amplitudes are at TTL logic levels.

4. The following is a troubleshooting example. Assume that a line has failed. For example, if RTS is suspect, check for the voltage levels listed below.

   a. A1U406

pin 8	6 Vp-p with a 1 volt DC offset
pin 9	4 V DC reference
pin 14	5 Vp-p with no DC offset

   b. A1U305

pin 6	5 Vp-p with no DC offset
pin 13	3 Vp-p with a .75 V DC offset

   c. A1U600

pin 8	12 Vp-p centered about a DC zero reference
pin 9	5 Vp-p signal with no DC offset
pin 10	2.5 V DC volt reference

5. Assume that the RTS MARK LED fails to light. If the LED is working properly, the following voltages will be present.

   a. A1U406

pin 2	1 Vp-p with a zero DC offset
pin 6	6 Vp-p with a 1 volt DC offset
pin 7	3 V DC reference

   b. A1U405

pin 14	5 Vp-p with a 1 V DC offset

E-21. DCE TROUBLESHOOTING

Enter the program in Table E-6, then follow the procedures in paragraph E-22.

Table E-6. DCE Test Program

Press	SET UP	
Select	SDLC	(Protocol)
	ASCII 8	(Code)
	DCE	(DTE clock)
	SYNC	(mode)
	9600	(Bits/sec)
	D & S	(Disp mode)
Press	(HALT)EXIT	
The Top Level Menu will be displayed.		
Select	SIMULATE	
	DCE	
Press	MORE	
Select	SET LEAD	
	CTS	
	OFF	
	AND THEN	
Press	MORE	
Select	SET LEAD	
	DSR	
	OFF	
	AND THEN	
Press	MORE	
Select	SET LEAD	
	CD	
	OFF	
	AND THEN	
	SEND	
Type in	CTS OFF	
Press	RTN (return)	

Table E-6. DCE Test Program (cont)

Select	AND THEN
Press	MORE
Select	WAIT
Type in	100
Press	RTN (return)
Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	CTS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	DSR
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	CD
	ON
	AND THEN
	SEND
Type in	CTS ON
Press	RTN (return)
Select	AND THEN
Press	MORE
Select	WAIT
Type in	100
Press	RTN (return)
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	RTS
	ON
	THEN GO TO
Type in	1
Press	RETURN
	(HALT)EXIT

E-22. Procedure

1. Connect jumpers between the following pins on TPB.

   2 and 3
   4, 5, and 24
   8 and 20

2. Close switches 2, 3, 4, 5, 8, 20, and 24.

3. To run the program entered in Table E-5:

Select	RUN MENU
	SIMULATE

a. Table E-7 describes the status of the HP 18179A indicators.

Table E-7. Indicators on HP 18179A During DCE Troubleshooting

Indicator	MARK	SPACE
DTE	on	on
DCE	on	on
TC	on	on
RC	on	on
RTS	blinking	blinking
CTS	blinking	blinking
DTR	blinking	blinking
DSR	blinking	blinkig
CD	blinking	blinking
ETC	on	on

4. If any of the above conditions fail, perform the following.

a. Use an oscilloscope to examine the transmitter associated with the failed channel. The minimum volage swing should be +- 10 volts. If the trouble is not found, proceed to step b.

b. Use an oscilloscope to examine the receiver associated with the failed channel. The inputs to the comparators should be 6 volts p-p with a one volt DC offset at the inverting inputs. All of the other amplitudes are TTL logic level.

5. Below is an example of the troubleshooting process. This example assumes that the DTR space LED is not working. The following voltages should be present.

a. A1U606

pin 10	6 Vp-p with no DC offset
pin 11	4 VDC
pin 13	5 Vp-p with no DC offset

b. A1U605

pin 10	5 Vp-p with no DC offset

APPENDIX F
HP 18178A
X.21 INTERFACE POD

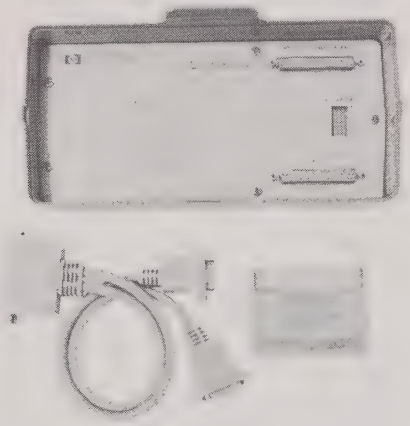


Figure F-1. HP 18178A Interface Pod

F-1. INTRODUCTION

The HP 18178A is an X.21 Interface Pod designed to provide a connection between the HP 4951 Protocol Analyzer and Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). With the HP 18178A Interface, the HP 4951 can monitor or simulate data on X.21 links.

This appendix includes information to install and service the HP 18178A.

F-2. Description

There are four major circuits:

Transmit	(T)	Control	(C)
Receive	(R)	Indication	(I)

Circuits T and C are controlled by the Data Terminal Equipment (DTE) and the R and I circuits are controlled by the Data Circuit Terminating Equipment (DCE). In addition to the four major circuits, there is a signal-element timing circuit (S), an optional byte-timing circuit (B), and two ground connections.

The electrical characteristics of the X.21 Interface are specified by voltages, currents, and impedances. These are covered by two different standards, one for balanced operation and another for unbalanced operation.

There are four phases of operation in the X.21 Interface.

Quiescent phase	Call Control phase
Data Transfer phase	Clearing phase

For More Information. For more information on the X.21 Interface, refer to the CCITT Recommendation, X.21 specification, Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Synchronous Operation on Public Data Networks, 1984.

F-3. INSTALLATION

To connect the Interface Pod to the HP 4951 Protocol Analyzer, turn the power off and attach the 37 pin connector to the port on the back of the Protocol Analyzer. Tighten the hex screws to ensure that the cable will not pull off during operation. Connect the X.21 Interface Cable to the device under test.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

Figure F-2. HP 18178A Interface Pod Connections

F-4. OPERATION

Once the Interface Pod is installed, all operations are performed from the keyboard. See the Hp 18178A Operating Manual for procedures.

F-5. PERFORMANCE VERIFICATION

The Performance Verification test is performed by the operator. Follow the procedure described in paragraph F-6.

F-6. HP 18178A SELF TEST

NOTES

Using an HP 4951 with REV 1.0 firmware will cause the HP 18178A Pod Extended Self Test to indicate a failure. This is normal for instruments with REV 1.0 Firmware, however, your X.21 Application Program will function properly

Also, instruments with REV 1.0 firmware will not display the X.21 mnemonics when in the monitor or simulate menus.

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and a verification that the lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select SELFTEST.
4. Select EXT DLC.

Procedure

1. When the EXT DLC softkey is pressed, the Interface Pod test is automatically performed.

2. If there are no failures DLC TEST PASSED will be displayed.

F-7. ADJUSTMENTS

There are no adjustments for the HP 18178A.

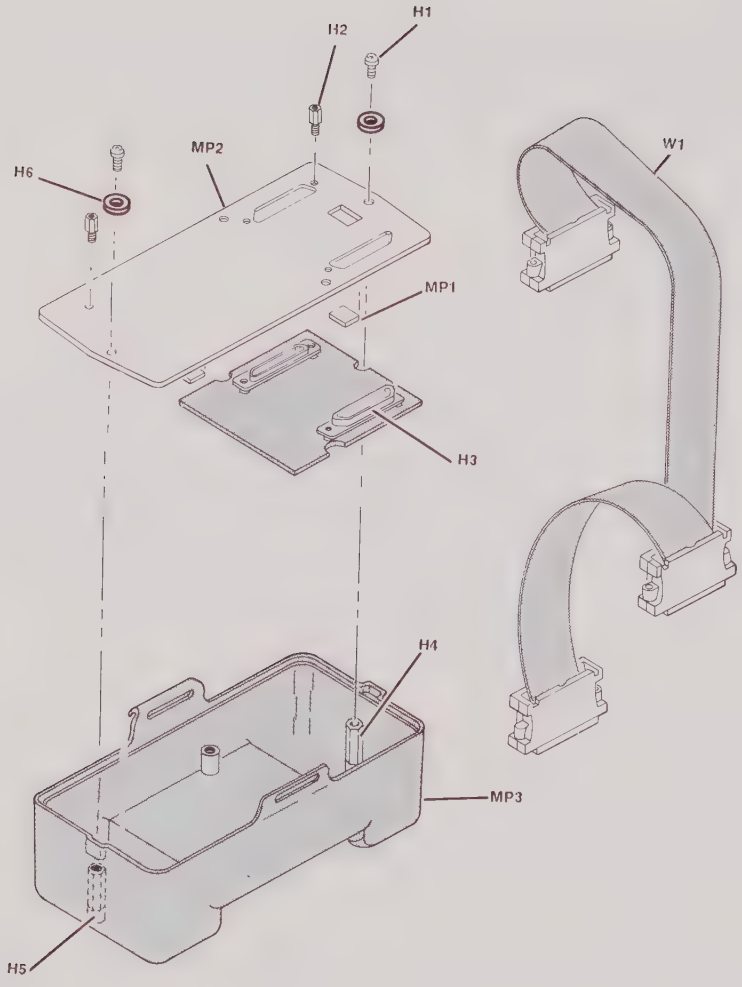
F-8. REPLACEABLE PARTS

The following tables and figure give information for ordering replacement parts. Table F-1 is the Manufacturer's Code List. Table F-2 lists the replaceable parts in alphanumeric order. Information is given for the Description, Quantity, HP Part Number, and Manufacturers Part Number. Chassis and mechanical parts are listed in Figure F-3. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table F-1. HP 18178A Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI 53204
04713	MOTOROLA SEMICONDUCTOR PROD	PHOENIX	AZ 85008
11236	CTS OF BERNE INC	BERNE	IN 46711
13606	SPRAGUE ELECT SEMICONDUCTOR DIV	CONCORD	NH 03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX 76067
24546	CORNING GLASS WORKS	BRADFORD	PA 16701
28480	HEWLETT-PACKARD COMPANY	PALO ALTO	CA 94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA 01247



H1	2360-0195	3	5	SCR, MCH, 6-32-312	04771	ORDER BY DESCR
H2	1251-2942	7	4	SCR POST LOCK KIT	04507	318 15-99-011
H3	1251-6074	4	2	CONNECTOR-37 PIN	04486	DC375V
H4	0380-1719	6	1	STANDOFF	28480	0380-1719
H5	0380-1720	9	2	STANDOFFS	28480	0380-1720
H6	2190-0876	3	5	WASHER, FLAT, #6		
MP1	5040-4478	5	1	LENS	00000	ORDER BY DESCR
MP2	18178-00001	7	1	X-21 PANEL	28480	5040-4478
MP3	5041-6749	4	1	HOUSING, COATED	28480	18178-00001
W1	18178-61601	8	1	X-21 Y CABLE	28480	5041-6749
					28480	18178-61601

Figure F-3. HP 18178A Exploded View

Table F-2. HP 18178A Replaceable Parts List

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	18178-60002	6	1	X.21 INTERFACE ASSY	28480	18178-60002
A2C1	0180-1846	6	2	CAPACITOR-FXD 2.2UF +-10% 35VDC TA	56289	150C225X9035B2
A2C2	0180-1846	6		CAPACITOR-FXD 2.2UF + 10% 35VDC TA	56289	150C225X9035B2
A2C3	0180-1746	5	2	CAPACITOR-FXD 15UF +-10% 20VDC TA	56289	150D156X9020B2
A2C4	0180-1746	5		CAPACITOR-FXD 15UF +-10% 20VDC TA	56289	150D156X9020B2
A2C5	0160-0576	5	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2DS1	1990-0883	7	1	DISPLAY-LIQ-XTAL	28480	1990-0883
A2J1	1251-6074	4	2	CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A2J2	1251-6074	4		CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A2R1	0698-3266	5	2	RESISTOR 237K 1% .125W	24546	C4-1/8-T0-1002-F
A2R2	0698-3266	5		RESISTOR 237K 1% .125W	24546	C4-1/8-T0-1002-F
A2R3	0699-0556	2	2	RESISTOR 5.11 1%	28480	0699-0556
A2R4	0699-0556	2		RESISTOR 5.11 1%	28480	0699-0556
A2R5	0757-0442	9	2	RESISTOR 10K 1% .125W	24546	C4-1/8-TO-1002
A2R5	0757-0442	9	2	RESISTOR 10K 1% .125W	24546	C4-1/8-TO-1002
A2R201	1810-0680	2	10	RESISTOR-NETWORK SIP	28480	1810-0680
A2R202	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R203	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R204	1810-0732	5	1	RESISTOR-NETWORK 6-SIP 10.0K OHM X5	01121	206A103
A2R301	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R302	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R303	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A1R304	1810-0780	3	2	RES NETWK SIP 2	28480	1810-0780
A2R401	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R402	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R403	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A2R404	1810-0680	2		RESISTOR-NETWORK SIP	28480	1810-0680
A1R405	1810-0780	3	2	RES NETWK SIP 2	28480	1810-0780
A2U100	1820-3373	7	1	IC MV CMOS /74HC MONOSTBL	28480	1820-3373
A2U101	1820-3396	4	1	IC GATE CMOS/74HC AND-OR-INV	28480	1820-3396
A2U103	1820-3081	4	1	IC FF CMOS/74HC D-TYPE POS EDGE	28480	1820-3081
A2U104	1820-3007	4	3	IC GATE CMOS/74HC EXCL-OR QUAD	28480	1820-3007
A2U200	1826-0759	9	3	IC COMPARATOR GP QUAD 14-DIP-C	04713	LM339J
A2U202	1820-2831	0	3	IC 75174 DRIVER	28480	1820-2831
A2U300	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C	04713	LM339J
A2U302	1820-2831	0	1	IC 75174 DRIVER	28480	1820-2831
A2U400	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C	04713	LM339J
A2U402	1820-2831	0		IC 75174 DRIVER	28480	1820-2831
A2U403	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD	28480	1820-3007
A2U404	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD	28480	1820-3007
	0380-0332	7	4	STANDOFF-RVT-ON .187-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
	1251-2942	7	4	SCREW POST LOCK	28480	1251-2942
	1251-7642	4	1	KEYING PLUG	28480	1251-7642

F-9. SERVICE

The following paragraphs contain service information for the HP 18178A. Included is the Theory of Operation, X.21 Signal Mnemonics, Troubleshooting, Component Locators, and Schematics.

F-10. THEORY OF OPERATION

The HP 4951 has three modes of operation.

Monitor mode
DTE simulate
DCE simulate

The X.21 Interface Pod has the following capabilities.

1. Translates voltages to and from X.27 and HP 4951 logic levels.
2. Displays EIA line signal status (of selected lines only).
3. Programmable for monitoring and DTE or DCE simulation.
4. Supports differentially driven category I circuits.

F-11. DLC.

Drivers A1U302, A1U202 and A1U402 convert the signal from single ended logic levels to a differential voltage waveform.

Receivers A1U400, A1U300, and A1U200 operate over a common mode voltage range from -7 to +7 volts and require a minimum differential of 200 mvolts to change states. They maintain operation over a differential voltage range from 200 mvolts to 6 volts; however, the positive common mode signal voltage cannot exceed the X.27 specification of 10 volts. A1U400, A1U300, and A1U200 are protected by from signal levels up to 12 volts.

The EIA status of the selected interface lines is displayed on a bargraph LCD. Clock and data indicators are flashed at a 2 Hz rate when line state transitions are detected. Table F-3 lists the X.21 pin assignments and signal definitions.

Table F-3. X.21 Pin Assignments

Pin Number	X.21 Signal Definition
1 Shield	Cable Shield
2 Ta	DTE Data
3 Ca	DTE Control
4 Ra	DCE Data
5 Ia	DCE Control
6 Sa	Signal Timing
7 Ba	Byte Timing
8 Ground	Signal Ground
9 Tb	DTE Data
10 Cb	DTE Control
11 Rb	DCE Data
12 Ib	DCE Control
13 Sb	Signal Timing
14 Bb	Byte Timing
15	no connection

Table F-4. Front Panel Data Network Interchange Circuits

Interchange Circuit Designation	Circuit Name	DATA		CONTROL		TIMING	
		From DCE	To DCE	From DCE	To DCE	From DCE	To DCE
T	Transmit		X		X		
R	Receive	X		X			
C	Control				X		
I	Indication			X			
S	Signal Element Timing					X	

F-12. TROUBLESHOOTING

Before troubleshooting the HP 18178A Interface Pod, verify that the HP 4951 is functioning correctly. Troubleshoot the portion of the Interface Pod that has failed. Table F-5 is the DTE test program and Table F-6 the DCE test program. When entering the program, "Press" indicates that the key is on the keyboard and "Select" indicates a softkey. Follow the test procedure given after each table.

NOTE

The LCD below the T on the front panel flashes when the Interface Pod is active.

NOTE

The X.21-BSC Application Tape must be loaded into the HP 4951.

Table F-5. DCE Test Program

Select	SET UP	
	X.21	(Protocol)
	ASCII 7	(Code)
	LRC	(ERR Chk)
	NORM	(Bit Sense)
	DCE	(DTE clock)
	9600	(Bits/sec)
	D & S	(Disp mode)
	None	(Suppress)
Press	(HALT)EXIT	

The Top Level Menu will be displayed

Select	SIMULATE
	DCE
Press	MORE
Select	SET LEAD
	I
	ON
	AND THEN
	SEND
Type in	AM I BROKEN ?
Press	RTN
Select	AND THEN
Press	MORE
Select	SET LEAD
	I
	OFF
	AND THEN
	MORE
	GOTO BLOCK
Type in	2
Press	RTN
Select	NEXT BLOCK
Press	MORE
Select	GOTO BLK
Type in	1
Press	RTN
	(HALT)EXIT

F-13. DCE TROUBLESHOOTING PROCEDURE

1. Run the program entered in Table F-5 as follows:

Select	RUN MENU
	SIMULATE

2. The results of the DCE Test Program should be displayed on the CRT as follows:

Line	Display
R	AM I BROKEN ?
I	pulses
C	high
R	high
lower T	high
upper T	not active

3. LCDs for R, S, and the one below T (in the top left corner) should be blinking.

4. The LCD for I should be turned on.

5. The following pins should be high:

IC	PIN NUMBERS High	TTL Level (pulsing)	1 Vpp at 4 VDC
U100		5,10,12	
U101		8,9,10,13	
U200		2	4,5
U202	4	1,2,3,5,6,7	
U300		2,13	4,5,10,11
U302	4,12	1,2,3,5,6,7	
U400		1	6,7
U404		11,12,13	

6. If any of the above conditions fail, troubleshoot that part of the circuitry.

NOTE

The X.21-BSC Application Tape must be loaded into the HP 4951.

Table F-6. DTE Test Program

Select	SET UP	
	X.21	(Protocol)
	ASCII 7	(Code)
	LRC	(ERR Chk)
	NORM	(Bit Sense)
	DTE	(DTE clock)
	9600	(Bits/sec)
	D & S	(Disp mode)
	None	(Suppress)
Press	(HALT)EXIT	

Use the Cursor Up key to scroll to the DTE clock setup

Select	SIMULATE
	DTE
Press	MORE
Select	SET LEAD
	C
	ON
	AND THEN
Select	SEND
Type in	AM I BROKEN ?
Press	RTN
Select	AND THEN
Press	MORE
Select	SET LEAD
	C
	OFF
	AND THEN
Press	MORE
Select	GOTO BLK
Type in	2
Press	RTN
Select	NEXT BLOCK
Press	MORE
Select	GOTO BLOCK
Type in	1
Press	RTN
	(HALT)/EXIT

F-14. DTE TROUBLESHOOTING PROCEDURE

1. Run the program entered in Table F-6 as follows:

   Select RUN MENU
   SIMULATE

2. The results of the DTE Test Program should be displayed on the CRT as follows:

Line	Display
upper T	AM I BROKEN ?
I	high
C	pulses
lower R	high
upper R	not active
lower T	high

3. The LCDs for T and the segment directly below it should be flashing.

4. The LCD for C should be turned on.

5. Check the levels at the following pins:

IC	NUMBERS High	Low	TTL Level (pulsing)	1 Vpp Signal at 4 VDC
U402	4,9,10,12	11	1,2,3,5,6,7	
U400			2,13	4,5,10
U300	8,9,14			
U200			1	6,7
U100			2,4,13	
U101			3,4,5,6	

6. If any of the above conditions fail, troubleshoot that part of the circuitry.

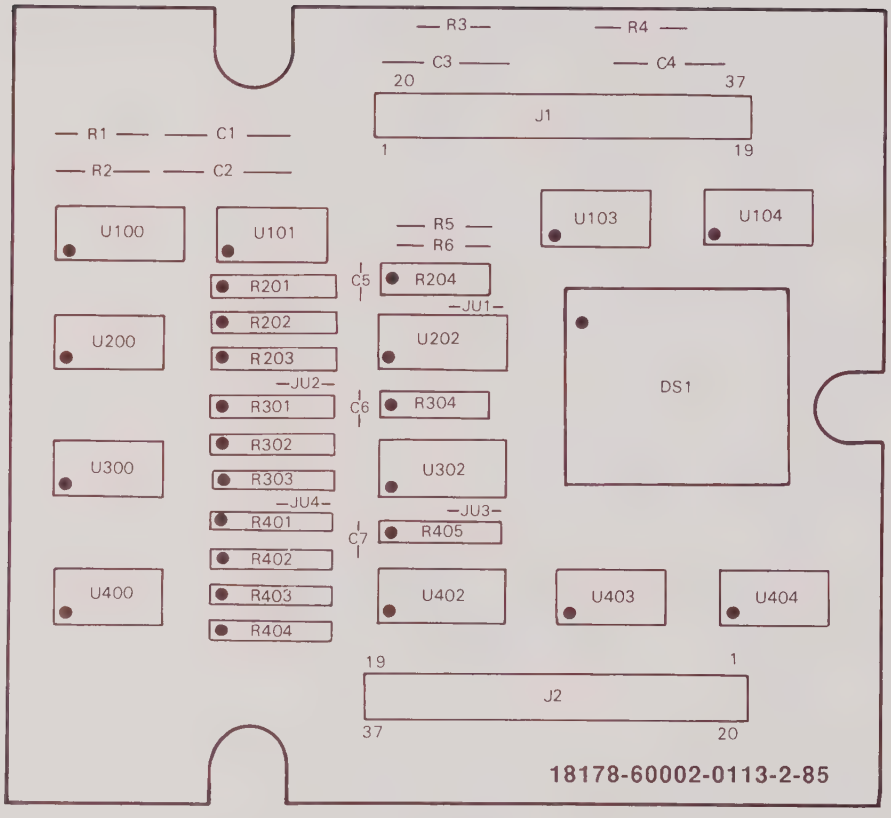


Figure F-3. HP 18178A Component Locator

APPENDIX G
HP 18197A
RS-232C/V.24/X.21 INTERFACE KIT

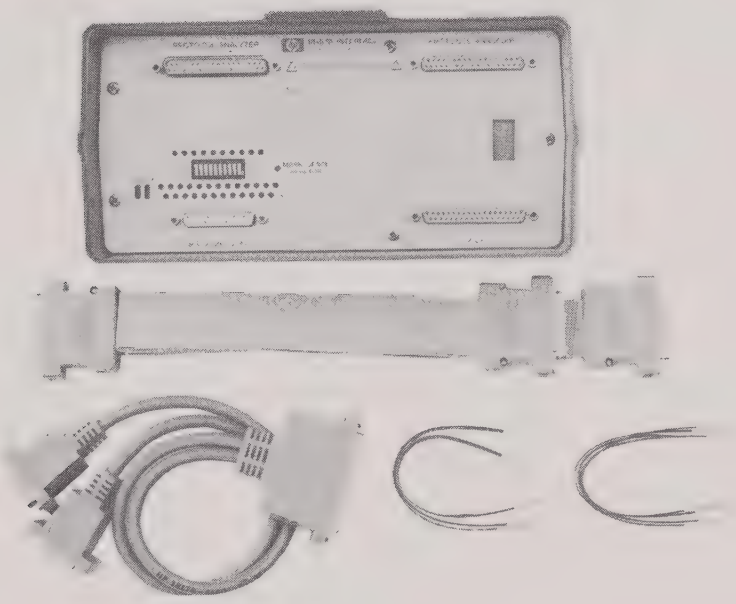


Figure G-1. HP 18197A Interface Kit

G-1. INTRODUCTION

The HP 18197A contains both the RS-232C/V.24 and X.21 Interface Pods, it is designed to provide the connection between an HP 4951 Protocol Analyzer and Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18197A contains both an HP 18173A and HP 18178A Interface Pod. For detailed descriptions of these Interface Pods, please refer to the appropriate appendixes.

This appendix includes information to install, operate, and service the HP 18197A.

G-2. INSTALLATION

To connect the Interface Pod to the HP 4951 Protocol Analyzer. Turn the power off and attach the 37 pin connector to the port on the back of the Protocol Analyzer as shown in Figure G-2. Tighten the hex screws to ensure that the cable will not pull off during operation.

Figure G-2. HP 18197A Interface Pod Connections

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

G-3. OPERATION

Once the Interface Pod is installed, all operations are performed from the HP 4951 keyboard. See the HP 4951 Operating Manual for procedures.

G-4. PERFORMANCE VERIFICATION

The Performance Verification test is performed by the operator from the HP 4951. Follow the procedure below.

G-5. HP 18197A Self Test

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

Set Up

1. Turn on the HP 4951.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. When the <EXT DLC> softkey is pressed, the Interface Pod test is performed.

2. If there are no failures, DLC TEST PASSED is displayed.

G-6. ADJUSTMENTS

The HP 18197A needs no adjustments.

G-7. REPLACEABLE PARTS

To order replacement parts refer to the appropriate appendix for RS-232C/V.24 or X.21. Chassis and mechanical parts are listed in Figure G-3. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table G-1. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	ANY SATISFACTORY SUPPLIER		
02848	HEWLETT-PACKARD	PALO ALTO	CA
04486	ITT CANNON ELECTRIC	SANTA ANA	CA
04507	TRW ELEK COMPONENTS	ELK GROVE VILLAGE	IL
05313	SEASTROM MFG CO	GLENDALE	CA
05610	COMCAR SCREW & MFG	ROCKFORD	IL

G-8. SERVICE

The HP 18197A contains both the RS-232C/V.24 and the X.21 Interface Pods. Service information and schematics for the RS-232C/V.24 and X.21 Interface Pods are located in the appropriate appendixes.

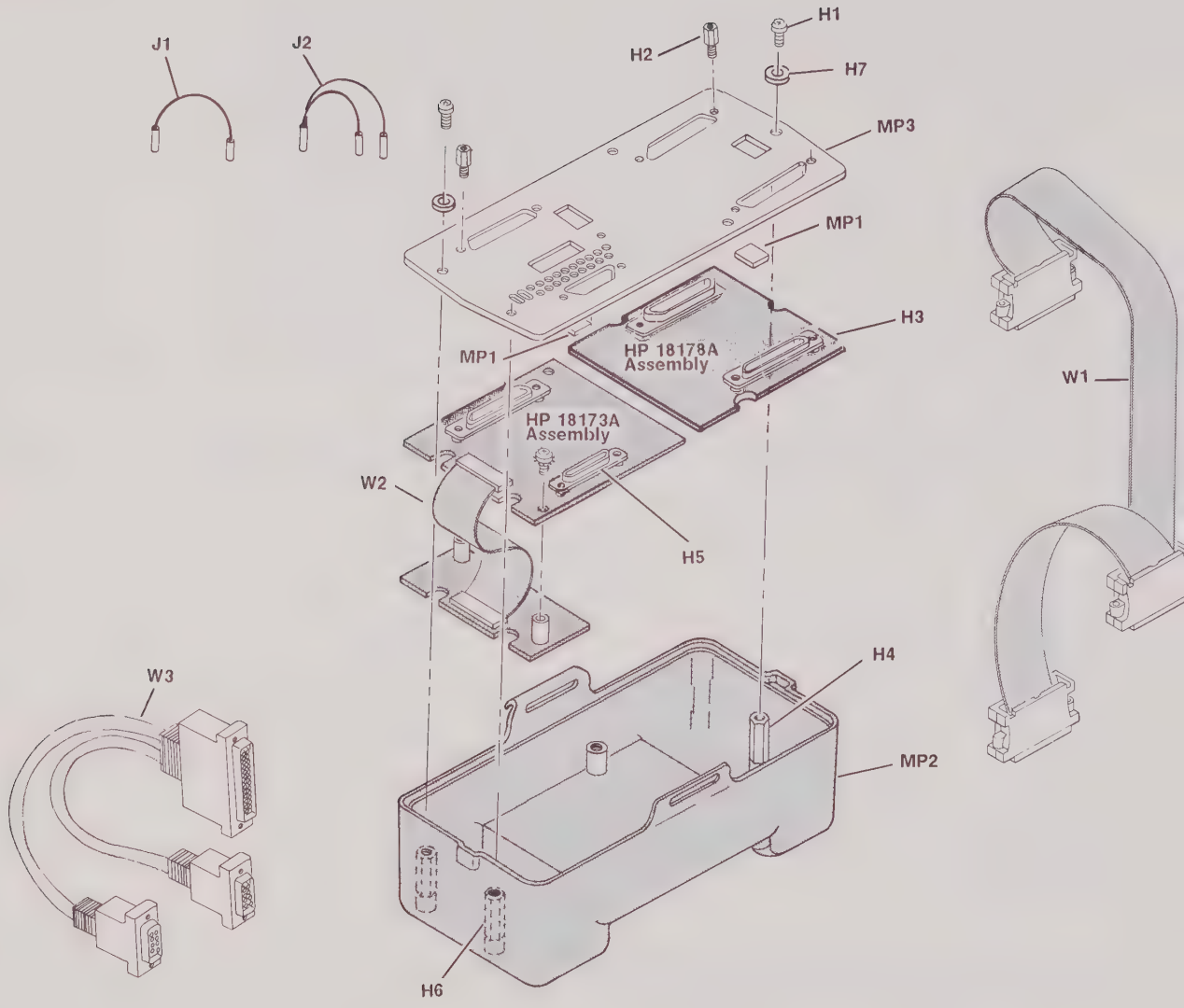


Figure G-3. HP 18197A Exploded View

Table G-2. Replaceable Parts List

REF DES	HP PART NUMBER	C D	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
H1	2360-0195	0	5	SCREW-MACH 6-32-IN-LG	05610	ORDER BY DESCR
H2	1251-2942	7	8	SCR POST LOCK KIT	04507	318-15-99-011
H3	1251-6074	4	1	CONNECTOR-37 PIN	04486	DC375V
H4	0380-1719	6	1	STANDOFF	28480	0380-1719
H5	1251-4946	5	1	CONNECTOR-25 PIN	04486	DB-255V
H6	0380-1720	9	2	STANDOFF	28480	0380-1720
H7	2190-0876	3	5	WASHER, FLAT #6 MTLE	05313	ORDER BY DESCR
J1	8120-4218	4	4	CABLE, JUMPER	28480	8120-4218
J2	8120-4219	5	2	CABLE, JUMPER	28480	8120-4219
MP1	5040-4478	5	2	LENS	28480	5040-4478
MP2	4040-2171	0	1	HOUSING	28480	4040-2171
MP3	18197-00001	0	1	RS-232C/V.24/X.21 PANEL	28480	18197-00001
W1	18178-61601	1	1	CABLE, X.21	28480	18178-61601
W2	18173-61601	3	1	CABLE, INTERCONNECT	28480	18173-61601
W3	18173-61602	5	1	CABLE, RS-232C/V.24	28480	18173-61602
	18173-61602	7	1	RS-232C/V.24 ASSEMBLY	28480	18173-61602
	18178-60002	5	1	X.21 ASSEMBLY	28480	18178-60002

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Yokogawa-Hewlett-Packard Ltd
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Telex 22481 AREEG KT
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August 1984

HP distributors are printed in italics.

S E R V I C E N O T E

4951B Protocol Analyzer

Assembly: 04951-60001 Main Board Assembly
04951-60014 Main Board Assembly
04951-60018 Main Board Assembly

Duplicate Service Notes: 4951A-19

Serial Numbers: 0000A00000/2612A03559

Parts Required:

HP P/N	Description
0699-1994	1.5 Megohm resistor
8159-0005	0.0 ohm resistor

Situation:
The 4951B Protocol Analyzer may exhibit dim or no display due to failure of A1R35 or A1R80, 750K ohm resistor, HP P/N 0757-0145. The resistors fail as a result of the maufacturer's process.

The 4951B can be repaired with a like resistor HP P/N 0757-0145, or the following modification can be done for repair.

If Modification Repair:
1. Remove A1R35 and A1R80
2. Install HP P/N 8159-0005 0.0 ohm resistor in R35
3. Install HP P/N 0699-1994 1.5M ohm resistor in R80
4. Perform 4951B Performance test

Date: 30 October 1989

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION:

INFORMATION ONLY

AUTHOR:	ENTITY:	ADDITIONAL INFORMATION:
NB	3800	

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S E R V I C E N O T E

Supersedes
4951B-04
(Dated 30 October 1989)

4951B Protocol Analyzer

Assembly:

	04951-60001	Main Board Assembly
	04951-60014	Main Board Assembly
	04951-60018	Main Board Assembly

Duplicate Service Notes: 4951A-21

Serial Numbers: 0000A00000/2612A03559

Parts Required:

HP P/N	Description
0699-1994	1.5 Megohm resistor
8159-0005	0.0 ohm resistor

Situation:
The 4951B Protocol Analyzer may exhibit dim or no display due to failure of A1R35 or A1R80, 750K ohm resistor, HP P/N 0757-0145. The resistors fail as a result of the maufacturer's process.

The 4951B can be repaired with a like resistor HP P/N 0757-0145, or the following modification can be done for repair.

If Modification Repair:
1. Remove A1R35 and A1R80
2. Install HP P/N 8159-0005 0.0 ohm resistor in R35
3. Install HP P/N 0699-1994 1.5M ohm resistor in R80
4. Perform 4951B Performance test

Date: 18 December 1989

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SERVICE NOTE CLASSIFICATION:

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